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- WHITNEY, F. O.—Admitted as Member, 1, 37.
- WHITTEMORE, D. J.—Member of Committee on Subscriptions to Building Fund, 112.
- WILLIAMS, ROBERT E.—Admitted as Member, 39.
- WILLIAMS, WM. PLUMB.—Admitted as Junior, 75.
- WILLIAMSON, F. Stuart.—Admitted as Member, 111, 154.
- WILSON, JOS. M.—Member of Committee on Subscriptions to the Building Fund, 112.
- WILSON, WILLIAM WILLARD.—Death announced, 39; Memoir of, 40.
- WORTHEN, WILLIAM E.—Elected President, 11; presides at meeting, 39, 43, 69, 75, 77, 84, 98, 111, 119, 129, 133, 141, 142.
- YEATMAN, CHARLES POPE.—Admitted as Member, 39, 42.

# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII.—January, 1887.

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## MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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### OF THE SOCIETY.

JANUARY 5TH, 1887.—The Society met at 20 o'clock. Vice-President Thomas F. Rowland in the Chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates were declared elected. As Members: Addison Connor, Plattsmouth, Neb.; Samuel Henry Shearer, Indianapolis, Ind.; Frank Ormond Whitney (elected Junior May 3d, 1876), Boston, Mass. As Juniors, Robert Cooke Clarkson, Philadelphia, Pa.; Henry Wilson Hodge, Phoenixville, Pa.

The death, on December 19th, 1886, of C. Shaler Smith, M. Am. Soc. C. E., and also the death of Sullivan Haslett, M. Am. Soc. C. E., on January 4th, 1887, were announced.

The election as Honorary Member of the Society of General James C. Duane, Chief of Engineers U. S. A., was announced, the election to date from November 20th, 1886.

The paper previously presented on the subject of Irrigation, by E. B. Dorsey, M. Am. Soc. C. E., was discussed by Messrs. H. V. Hinckley, Frederick Eaton, Edward Mead, H. A. Brainard, A. D. Foote, C. L. Stevenson and Thomas C. Clarke.

## THE ANNUAL MEETING OF THE SOCIETY.

JANUARY 19TH, 1887.—The meeting was called to order by John Bogart, Secretary, at 10 o'clock, who stated that he was requested by a letter from President Henry Flad, to express his regret that he had been unable to come from St. Louis to New York to preside at this meeting. On motion of Mr. James B. Francis, Past President, Mr. Charles E. Emery was elected to take the chair. Messrs. J. F. Sorzano, F. A. Calkins and A. F. Noyes were appointed tellers to canvass the ballot for officers. On motion it was ordered that the ballot close at noon.

The Annual Report of the Board of Direction\* was read by the Secretary, and, on motion, accepted.

The Annual Report of the Treasurer\* was read by the Treasurer, and, on motion, accepted.

The Report of the Finance Committee\* was read, and, on motion, accepted.

The Report of the Board of Censors to award the Norman Medal was read and adopted; it is as follows:

The Board of Censors to award the Norman Medal for the year terminating August 1st, 1886, report that in their judgment the award should be made to paper No. 318, English and American Railroads Compared, by Edward Bates Dorsey, M. Am. Soc. C. E.

Respectfully submitted,

THOMAS C. MEYER, New York.  
FREDERIC GRAFF, Philadelphia.  
CHARLES E. GREENE, Ann Arbor.

The Report of the Committee to award the Rowland Prize was read and adopted; it is as follows:

The Committee appointed to award the Rowland Prize for the year terminating the 1st day of August, 1886, reports that, in its judgment, the prize should be awarded to Paper No. 317, "The Cantilever Bridge at Niagara Falls," by Charles C. Schneider, M. Am. Soc. C. E.

Respectfully submitted,

F. DE FUNIAK, Louisville.  
FRED. H. SMITH, Baltimore.  
JOHN BOGART, New York.

The Report of the Committee on Uniform Standard Time was presented and read; it is as follows:

## REPORT OF THE SPECIAL COMMITTEE ON STANDARD TIME.

NEW YORK, January 19th, 1887.

At the last annual meeting the committee referred to the progress made at that date in the movement of time reform. Among other things,

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\* Printed separately following this report.



the report mentioned the fact that it was publicly announced that the Canadian Pacific Railway Company had decided to test the advantages claimed for the 24-hour system of notation by an actual trial on a portion of their trans-continental line.

Accordingly, at midsummer last year, when the through line was opened for public traffic, the time tables were arranged for the change of notation between Port Arthur, on Lake Superior, and Vancouver, on the Pacific Coast. This portion of the railway comprises the Western and Pacific Divisions, 1913 miles of main line, which, together with branches and connections using the new system embrace in all over 2 600 miles of railway. It extends across the "Central," the "Mountain" and the "Pacific" standard time zones, being those governed by the time of the 90th, the 105th and 120th meridians of west longitude. The management of the railway company deemed it expedient to test the new notation experimentally on those divisions before adopting it on the whole line.

The Vice-President, Mr. Van Horne, has placed at the service of the committee a large number of letters received on the subject from the principal officers on the Western Division, conductors and agents, mayors of cities, the Lieutenant-Governor and the Premier of Manitoba, and others. These letters, furnishing information as to the results of the experiment during six months which have intervened, are herewith submitted. They are obviously from shrewd, practical business men, whom it may be assumed are in no way influenced by any sentimental desire for the introduction of a novel and hitherto untried system of reckoning time. On the other hand, it is reasonable to suppose that the writers of the letters would partake of the same dislike to a departure from an old established custom which is natural to the majority of people. However that may be, their attachment to the traditional usage has been completely overbalanced by the inherent merits of the new notation.

The letters appended afford overwhelming testimony on two points, viz.:

*First.*—The great advantages of the twenty-four hour system in operating railways.

*Second.*—The readiness with which the business men and the general public accept the change.

It is surprising that people should with so little hesitation abandon a usage with which they have been familiar from childhood to adopt what may be looked upon as an innovation. The circumstances may be taken as an evidence of the intelligent appreciation by the general public of the advantages of the new notation. So far not a single voice has been heard against its use. The newspaper press has everywhere advocated the change, and no person whatever throughout the vast territory has expressed a desire to return to the old system of reckoning.

The experiment of the last six months has determined the Canadian Pacific Railway Company to adopt the twenty-four hour system permanently on every division, every branch, and every connecting line under its control. The next time tables issued will extend the use of the new notation eastward to Toronto and to Ottawa, the capital of the Dominion. In another year, when the extensions of the Pacific Railway will be completed, it is expected that the twenty-four hour system will be put in force within the limits of every Province of Canada, from Nova Scotia on the Atlantic, to British Columbia on the Pacific.

This practical test is undoubtedly an outcome of the action taken by the American Society of Civil Engineers during the past six years. The

signal success which has attended the experiment is a first fruit of the movement, which clearly points to most important results in the not distant future. It appears to the committee to settle every objection of any consequence which has at any time been raised, and foreshadows the ultimate general adoption of the new notation.

The committee respectfully suggest that the accompanying documents be printed and widely circulated for the information of all concerned in the successful operation of our gigantic continental railway system.

SANDFORD FLEMING,  
*Chairman.*

HOUSE OF THE SOCIETY,  
NEW YORK, January 17th, 1887.

The Committee also presented the following resolutions for the consideration of the annual meeting:

*First.*—That the report of the Special Committee on Standard Time now submitted be accepted, and the committee continued.

*Second.*—That a copy of the report and the accompanying letters be transmitted to the secretary of the several railway time conventions, with the request that they take into consideration the propriety and expediency of adopting the twenty-four hour system on all the railways in North America at the next change of time table.

*Third.*—That, in view of the general introduction of the twenty-four hour method of counting the hours of the day, it is desirable to take means to familiarize the public with the change. Be it therefore

*Resolved,* That a respectful request be transmitted by the Society to the mayor and corporations of the principal cities in the United States, Canada and Mexico to have the dials of public clocks adapted to the new notation.

*Fourth.*—That for the reason expressed in resolution number three, a respectful request be made to the Post Office Department of the United States, Canada and Mexico to introduce the twenty-four hour system of notation in the post offices of the country and in such publications on postal affairs as refer to the hours of the day.

*Fifth.*—That the special committee be authorized to take such farther action as may be deemed expedient to advance this important movement.

The first resolution was adopted. The second resolution was, on motion, amended—and, as amended, adopted—so as to read as follows:

That a copy of the report and accompanying letters be transmitted to the secretaries of the several railway time conventions with the request that they take into consideration the propriety and expediency of adopting the twenty-four hour system on all the railways in North America at the next change of time tables; and that the Board of Direction of this Society be authorized, if they consider it expedient, to send copies to the leading railway officials of the country.

The third and fourth resolutions were, on motion, laid over. The fifth resolution was, on motion, amended—and, as amended, adopted—so as to read as follows:

That the special committee be instructed and authorized, with the approval of the Board of Direction, to take such further action as may be deemed expedient to advance this important movement.

On motion of Mr. F. Collingwood the following resolution was adopted to take the place of the third and fourth resolutions submitted by the committee:

It is the sense of this Society that it is desirable, for the purpose of familiarizing the public with the change involved in the introduction of the twenty-four hour system, that the mayors and corporations of the principal cities in the United States, Canada and Mexico have the dials of public clocks adapted to the new notation; also that it is desirable that the Post Office Departments of the United States, Canada and Mexico introduce the twenty-four hour system of notation in the post offices of the country, and in such publications on postal affairs as refer to the hours of the day.

The recent death of Mr. Justus Dirks, of Holland, Honorary Member of the Society, was announced.

The report of the Committee on the Compressive Strength of Cements and the Compression of Mortars and Settlement of Masonry was presented by the Chairman, Mr. Collingwood, and, on motion, the report was accepted and the Committee continued. The report is as follows:

REPORT OF PROGRESS OF THE COMMITTEE ON THE COMPRESSIVE STRENGTH  
OF CEMENTS AND THE COMPRESSION OF MORTARS AND SETTLEMENT OF  
MASONRY.

Your Committee beg leave to make a partial report at the present time. Considerable correspondence has been carried on, with discussion of methods, etc. The Members located in New York are now provided with special moulds for the specimens required, and arrangements have been made for beginning a series of experiments on a special branch of the inquiry.

Prof. Swain, of the Committee, has forwarded a report of his work, which is herewith presented, but it is not yet in a sufficiently forward state for discussion. The Committee will present a discussion of the results of the Watertown experiments whenever they may be available. They cover an important portion of the field, but they leave another even more important part entirely untouched. The Committee respectfully ask to be continued.

F. COLLINGWOOD,  
*Chairman.*

COMMUNICATION FROM PROF. GEORGE F. SWAIN, MEMBER OF THE  
COMMITTEE.

I submit the following brief report on the progress of the work intrusted to me, namely, on the Behavior of Cements during Induration. The apparatus and method of experiment which I finally adopted, and which I believe is accurate enough to detect very small changes of dimension, may be briefly described as follows: A casting, of the form and dimensions shown in Figs. 1 and 2, has set into it two steel points, *a* and *b*. Of these, *a* has not a sharp point, but is planed off to a circle about one-sixteenth of an inch in diameter, while *b* is pointed. This casting allows the use of 10-inch cubes of cement, but thus far I have only tried 5-inch cubes, which are placed upon a wooden platform *c*.

These cubes are carefully made in a wooden mould shown in the sketches (Fig. 3), the sides being held together by wedges. The mould is kept well oiled, and strong cleats on each side prevent the sides

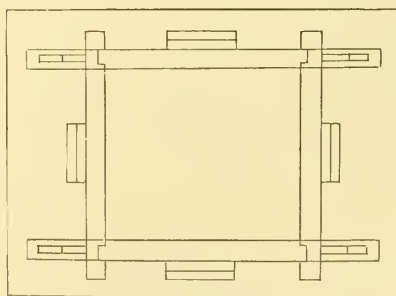
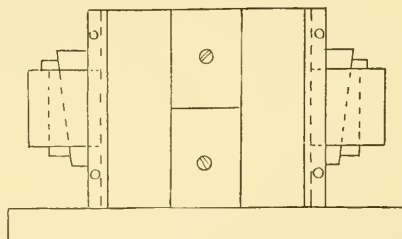
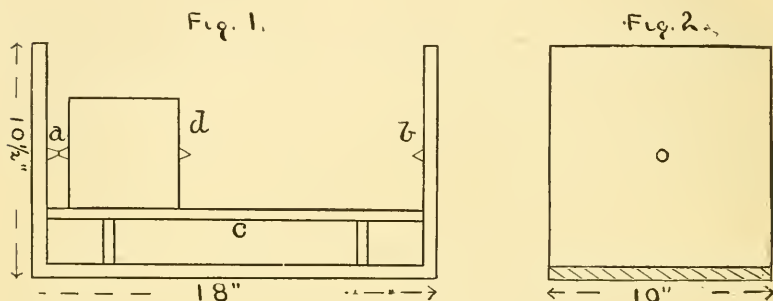


Fig. 3

from warping. When sufficiently indurated, the cube is taken from the mould, and a brass tack with pointed head is driven in each of its four sides so as to be precisely opposite the points *a* and *b* in Fig. 1. For measurement, the cube is placed on the platform *c* and moved up against the piece *a* until the tack bears full against the planed surface. It is then exactly oriented so that the two tacks are squarely in the line *a b*, and the distance *b d* is measured with a Brown & Sharpe micrometer gauge



arranged as in Fig. 4. Readings are taken to ten-thousandths of an inch, and the measurements are checked until two agree. The temperature is noted, and will be corrected for in the results. Six cubes are made of each kind of cement, three being left in air, and the other three immersed in water. Of each set, one is made of neat cement, one of a mixture of 1 to 1, and one with 1 to 2. One of cement to three of sand was tried, but the cubes are liable to be injured in the hand-

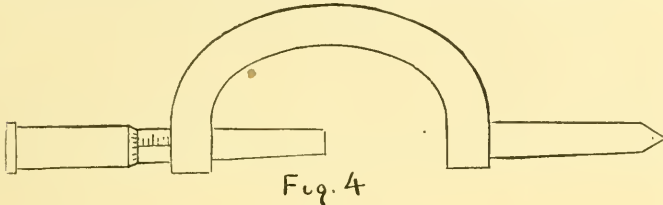


Fig. 4

ling, and the mortar was therefore discontinued. Measurements are made at intervals after the cubes are formed, of one day, two days, one week, two weeks, four weeks, six weeks, eight weeks, twelve weeks, and sixteen weeks. I believe that this apparatus and method of measurement is fully as accurate, while very much more simple, than that used by Prof. Bauschinger, and illustrated on page 725 of the Transactions for October, 1886. It would be interesting to know the effect of loads upon the changes of dimension, but no experiments in this direction have thus far been undertaken. They would require some modification in the apparatus, and it is hoped to carry them out later.

It is scarcely necessary to give any detailed results at the present time, and in fact, as the observations have not yet been reduced and corrected for temperature, it is not at this moment possible. The cements thus far experimented with have been Norton's, Newark and Rosendale, Saylor's, Hoffman, and the Obelisk brand of the Standard Cement Company; and it will suffice to say here that in no case has the change of dimension amounted to 0.01 inch in a period of six to eight weeks. Some of the cubes show a progressive contraction, others a progressive expansion, others still an initial contraction with subsequent expansion, while others show the reverse. It is hoped that by the time of the annual convention the experiments will be complete enough to have the results submitted in full.

In connection with the report, I would also beg to state that I recently visited the Watertown Arsenal for the purpose of ascertaining what experiments on the compression of cements and of masonry had been made there. Reference to the records showed a very large amount of material of just the kind desired by this Committee. The experiments were completed some two years ago, but have not yet been published. They are, however, now in press, and are expected to appear at any day, and I therefore made no detailed extract from the records. Among others, the experiments include:

- (a.) Crushing test of 6-inch cubes of lime, and of Portland and Rosendale cements, neat, and mixed with sand in various proportions, with measurements of the compression.
- (b.) Tests of cubes of other cements, of various sizes, from 2 to 12-inch cubes. All these cubes had been kept in air, and were at least two years old. No experiments were made on cubes at ages of less than two years. Before testing, the faces of these cubes were all dressed with plaster of Paris to a small thickness.

- (c.) Crushing tests of piers of various kinds of brick, laid up in various ways. The dimensions of the piers varied from 8 inches to 16 inches square, and from 24 inches up to over 12 feet long. Hollow piers 12 inches square and from 23 inches to 10 feet long were also tested. The ages of all of these were nearly the same, viz., from one and one-half to two years.

These experiments will, it seems to me, afford great aid to this Committee; but it is to be regretted that they could not have been made rather more complete, and covering more points of interest, such as the effect of various ages, of various mortars, and of various permanent loads.

In closing, I would state that all the experiments in my laboratory have been performed by two of my students, Mr. W. C. Cushing and Mr. W. S. Thompson, in the accuracy of whose work I have full confidence.

Yours respectfully,

GEORGE F. SWAIN.

The report of the Committee to consider the Proper Relations to each other of the Sections of Railway Wheels and Rails was presented and read, as follows:

The Committee on the Proper Relation to Each Other of the Sections of Rails and Wheels have the honor to report that they have held three meetings for the consideration of the subjects submitted to them, and are now gathering statistics to determine more fully the facts in relation to the question; but that the engagements of the members have prevented them from making as rapid progress as might be wished, and it is only recently that they have been able to give proper attention to the matter. They hope to be able to prepare a report in time for submission at the next Annual Convention, or earlier.

The question submitted to them divides itself into two parts: the effect of the form of the rails and wheels upon the wear of the wheels, especially in relation to sharp flanges; and the effect upon the wear of the rails, especially in regard to flange-cutting on curves or on straight lines. The point which the Committee particularly desire to investigate, and are now gathering quite extended statistics upon, is to what extent, if any, sharp flanges appear to be caused by the form of the rails, and to what extent the wear of the rails is modified by the fillet of the wheel fitting more or less perfectly around the corner of the rail.

Until the statistical facts are gathered in respect to these questions, the Committee are not able to express any definite opinions, and they therefore submit this report of progress merely, and ask to be continued.

Respectfully submitted,

H. STANLEY GOODWIN,

*Chairman, for the Committee.*

On motion, the report was accepted, and the Committee continued.

The Committee on Joint Library presented the following report, which, on motion, was accepted, and the Committee continued:

Your Committee on Joint Library begs leave to report that the Joint Committee of the several societies interested, the organization of which was stated in our report submitted at the last annual meeting, held a meeting early in 1886, and appointed a sub-committee consisting of one Mem-

ber from each society, which has since been engaged in endeavoring to get the necessary information to enable the formulating of a plan for establishing a joint library which should have reasonable prospect of being successful and of meeting the approval of the societies interested.

The Sub-Committee has not yet met with signal success, but there are prospects which the undersigned believes will warrant a continuance of your Committee for another year.

All of which is respectfully submitted.

For the Committee,

WILLIAM P. SHINN,  
*Chairman.*

A summary of suggestions received in reference to places for holding the Annual Convention was presented, as follows:

The following summary of replies received in reference to the place for holding the next Convention was presented:

Pittsburgh	was suggested by.....	34
New York	“ .....	12
San Francisco	“ .....	10
Thousand Islands	“ .....	8
London, England,	“ .....	7
Boston,	“ .....	6
Cresson,	“ .....	6
Saratoga,	“ .....	6
Washington	“ .....	6
Chicago	“ .....	5
Atlanta, Ga.,	“ .....	4
Montreal	“ .....	3
Fortress Monroe	“ .....	3
Charleston, S. C.,	“ .....	3
Chattanooga, Tenn.,	“ .....	3
Paris, France,	“ .....	3
Burlington, Vt.,	“ .....	3
Cincinnati	“ .....	3
Catskill	“ .....	3
Newport, R. I.,	“ .....	2
New Orleans	“ .....	2
Louisville, Ky.,	“ .....	2

The following places were also suggested in the replies received: Toledo, Block Island, Providence, Portland, Minneapolis, Gettysburg, Vineland, N. J., Poughkeepsie, Annapolis, Baltimore, Ottawa, Niagara Falls, Asheville, N. C., Detroit, St. Louis, Montgomery, Manchester by the Sea, Nashville, White Sulphur Springs, St. Paul, Kansas City, Troy, Indianapolis and Deer Park.

Mr. W. HOWARD WHITE.—To start the debate I move that Pittsburgh be selected.

A Member asked if any invitations had been received. The Secretary said that no invitations had been received, and added that, at the request of a number of Members who had attended recent Conventions, he would call attention to some of the results of the experience of past Conventions. The experiment at Deer Park was in many respects very sat-

isfactory, both as regarded the discussion of technical subjects and of subjects connected with the future progress and welfare of the Society, to both of which much more time had been given than at any former Convention of the Society, and while this was true, it was also the fact that there was at Deer Park an opportunity for Members to become acquainted with each other, and to secure that social and personal intercourse which is perhaps fully as important an object of the Conventions as any other. The reasons for the successful results in these directions was that there was available a commodious hotel and large meeting-room connected with the hotel, and nothing to distract attention from the professional and social objects of the Convention. At the meetings in cities the Local Committees feel, and feel with reason, that objects of interest in and about the city should be inspected, and in every such case it has been impossible to secure the time for the real work of the Convention to the extent which the Members generally have desired. There is also extreme difficulty in securing at any city sufficient suitable accommodation for the number which now attend our Conventions. Only those who have experience know the discomfort there is in being scattered among three or four hotels. At the Annual Meeting of 1885, circulars which had been prepared by the Board of Direction and a Committee of Members of the Society were considered, and their suggestions adopted. These circulars suggested that the objects of the Convention were the presentation, consideration and discussion of professional subjects; an opportunity for free intercourse between Members of the Society gathered at our Conventions; and also such opportunities for social recreation as might not interfere with these two objects. They also suggested that some of the undesirable features of past Conventions were the entirely too limited time given to the presentation and discussion of professional and Society subjects; the entirely too large amount of time taken up in local excursions by the whole body of the Convention to points and objects not really of general interest; and also the disagreeable feeling of obligation arising from the fact that large sums of money were raised generally at cities where Conventions were held, and the feeling that this money should be spent in providing excursions and furnishing entertainments of a more elaborate character than is really required. At the time that Deer Park was decided upon, a number of other places were considered by the Board of Direction where similar accommodation could probably be secured, among them Fortress Monroe, Saratoga, the Hotel Kaaterskill, the Thousand Islands, Newport News, Va., Newport, R. I., Niagara Falls, Atlantic City, and probably some other points.

A number of our Western Members had expressed the desire that the next Convention should be held at some place on the Atlantic seaboard, as we went so very far West last year.

Mr. J. J. R. Croes suggested that there were excellent accommoda-

tions at the Hygeia Hotel at Fort Monroe, and that it could be reached pleasantly by steamer or by rail.

Mr. EDWARD P. NORTH recalled the suggestion made two years ago as to Saratoga, and the pleasant excursions possible in going to and returning from that place. There are there hotels of ample capacity to accommodate the whole Society.

Mr. C. G. FORCE suggested the consideration of the Thousand Islands as having many advantages.

Mr. E. L. CORTHELL said that he had conversed with many Members and had concluded that the general feeling was that the Convention at Deer Park was the most useful in the experience of the Society, and that such a place should, if possible, be selected. He also referred to the Hotel Kaaterskill as a very desirable location.

He offered the following resolution as an amendment to that of Mr. White:

*Resolved*, That the determination of the time and place of the next Convention be referred to the Board of Direction with power, and with the expression of the Annual Meeting that the place should be where there was one hotel sufficient to accommodate all attending the Convention, and not at a city.

On motion the above resolution was adopted.

The report of the Committee appointed to canvass the ballot for officers of the Society was presented, as follows:

NEW YORK, January 19th, 1887.

#### AMERICAN SOCIETY OF CIVIL ENGINEERS.

The Tellers appointed to canvass the vote for officers of the Society at the Annual Meeting of this date respectfully report:

The total number of ballots found correct and counted was 239.

For *President*: William E. Worthen, 237. For *Vice-Presidents*: Thomas C. Keefer, 235; Thomas F. Rowland, 235; Edward H. Keating, 1; J. F. Barnard, 1. For *Secretary and Librarian*: John Bogart, 239. For *Treasurer*: J. James R. Croes, 238. For *Directors*: William G. Hamilton, 237; Charles C. Schneider, 234; Stevenson Towle, 233; James Archbald, 237; Robert Forsyth, 239; and the following Members one vote each: William R. Hutton, D. McN. Stauffer, L. L. Buck, Francis Collingwood, G. S. Greene, Jr., Joseph P. Davis, Theodore Cooper, Charles Macdonald.

Respectfully submitted,

JULIO F. SORZANO,	} <i>Tellers.</i>
F. A. CALKINS,	
A. F. NOYES,	

The following Members were thereupon declared elected officers of the Society for the ensuing year:

*President*: WILLIAM E. WORTHEN.

*Vice-Presidents*: THOMAS C. KEEFER, THOMAS F. ROWLAND.

*Secretary and Librarian*: JOHN BOGART.

*Treasurer*: J. JAMES R. CROES.

*Directors*: WILLIAM G. HAMILTON, CHARLES C. SCHNEIDER, STEVENSON TOWLE, JAMES ARCHBALD, ROBERT FORSYTH.



The session of the Annual Meeting was resumed at 15.15 o'clock, after luncheon; General George S. Greene, Past President, in the chair. Mr. William E. Worthen presented a piece of a large iron conduit which was put down in Lowell at 1845, and which was still in good condition. The subject of the preservation and condition of wrought and cast-iron water conduits after long use was discussed by Messrs. William E. Worthen, J. J. R. Croes, James B. Francis, Frederic Graff, M. M. Tidd, W. Howard White and George S. Greene, Jr.

The session of the Annual Meeting was resumed in the evening at 20.30 o'clock, General George S. Greene, Past President, in the Chair.

A description of a six-hundred ton testing machine recently erected at Athens, Pa., was presented by Charles Macdonald, M. Am. Soc. C. E., and the subject of tests and testing machines was discussed by Messrs. F. H. Parker, G. Bonscaren, George S. Morison, A. H. Emery, George S. Greene, Theodore Cooper, Charles E. Emery, A. M. Wellington and Charles Macdonald.

On Thursday morning, January 20th, an excursion was made over the line of the Second Avenue Elevated Railway to the Harlem River, and thence over the lines of the Suburban Rapid Transit Railway north to the Harlem River. The new railway draw-bridge of the Suburban Rapid Transit Railway was inspected. A steamboat was then taken to the works of the Continental Iron Company at Greenpoint, where lunch was served and the operations in progress in those works inspected, particularly the very recent improvements in welding. The statue of Liberty Enlightening the World was then visited and inspected from base to torch. In the evening a reception was held at the Society House.

On Friday morning, January 21st, a large number of Members visited the lines of the new Cable Railway on One Hundred and Twenty-fifth street and on Tenth Avenue. Afterwards the New York and Brooklyn Suspension Bridge and its appliances were inspected; also the cold storage warehouses and the ice machines in one of the storehouses under the New York approach to the bridge were visited. The works of the New York Steam Company were inspected in the afternoon.

The Members of the Society, 145 in number, present at the Annual Meeting, excursions, etc., were: Arthur V. Abbott, Julius W. Adams, Edward R. Andrews, James Archbald, John W. Bacon, Frederick H. Baldwin, Thomas W. Baldwin, John F. Barnard, O. W. Barnes, Arthur Beardsley, John A. Bensel, George H. Bishop, H. Bissell, John Bogart, William F. Booth, Henry R. Bradbury, Josiah A. Briggs, Roswell E. Briggs, A. G. Brinckerhoff, H. W. Brinckerhoff, Thomas E. Brown, Jr., Charles B. Brush, Andrew Bryson, M. J. Butler, Frank A. Calkins, George W. Cass, S. H. Chittenden, Thomas C. Clarke, Francis Collingwood, Theodore Cooper, E. L. Corthell, J. James R. Croes, Joseph P.

Davis, Thomas Egleston, Howard N. Elmer, Charles E. Emery, Charles A. Ferry, George S. Field, Clark Fisher, J. Foster Flagg, Robert Fletcher, C. G. Force, M. N. Forney, James B. Francis, John R. Freeman, George H. Frost, Bryant Godwin, H. Stanley Goodwin, E. Sherman Gould, Frederic Graff, Samuel M. Gray, George S. Greene, George S. Greene, Jr., Edward B. Guthrie, Stephen S. Haight, William G. Hamilton, George E. Harding, Charles M. Harris, Robert L. Harris, Bentley D. Hasell, William J. Haskins, Albert B. Hill, Warren E. Hill, S. W. Hoag, Jr., John Houston, C. W. Hunt, William R. Hutton, C. E. Jackson, William P. Judson, George A. Just, Charles Kellogg, Cassius W. Kelly, George A. Kimball, Joseph M. Knap, Frank M. Leavitt, G. Leverich, Horace Loomis, Thomas D. Lovett, Charles Macdonald, William W. Maclay, George B. Mallory, Henry Manley, C. C. Martin, D. E. McComb, T. H. McKenzie, G. W. McNulty, Henry C. Meyer, Thomas C. Meyer, George S. Morison, Charles H. Myers, John Newton, O. F. Nichols, W. A. Nichols, Alfred Noble, Edward P. North, Albert F. Noyes, Ellis B. Noyes, F. S. Odell, Joseph O. Osgood, A. B. Paine, William H. Paine, H. W. Parkhurst, Henry C. Parsons, John A. Partridge, George H. Pegram, F. C. Prindle, Samuel Rea, Joseph R. Richards, B. Frank Richardson, William Roberts, Charles L. Rowland, Thomas F. Rowland, Jr., Henry F. Rudloff, William Rumble, E. S. Safford, J. Gardner Sanderson, C. C. Schneider, Henry B. Seaman, Lucius A. Smith, Miller A. Smith, Julio F. Sorzano, D. McN. Stanffer, Waterman Stone, Cook Talcott, Joseph R. Thomas, M. M. Tidd, George C. Tingley, Calvin Tomkins, Stevenson Towle, E. E. Russell Tratman, Alfred W. Trotter, E. B. Van Winkle, Montgomery Waddell, C. C. Waite, Charles D. Ward, James R. Wardlaw, A. M. Wellington, E. B. Weston, W. Howard White, Frank O. Whitney, William H. Wiley, C. J. H. Woodbury, William E. Worthen, Preston K. Yates and A. J. Zabriskie.

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#### OF THE BOARD OF DIRECTION.

JANUARY 5TH, 1887.—Applications were considered. Appropriations were made.

JANUARY 12TH, 1887.—The Secretary presented final draft of Annual Report, which was considered, revised and adopted.

JANUARY 21ST, 1887.—In accordance with the provisions of the Constitution, the following Standing Committees were appointed:

On Finance: Messrs. Thomas F. Rowland, William G. Hamilton and Stevenson Towle.

On Library: Messrs. J. James R. Croes, C. C. Schneider and James Archbald.

JANUARY 26TH, 1887.—Applications were considered.

## REPORT OF THE BOARD OF DIRECTION FOR THE YEAR ENDING DECEMBER 31st, 1886.

PRESENTED AND ACCEPTED AT THE ANNUAL MEETING, JANUARY 19TH,  
1887.

The Board of Direction, in compliance with the provisions of the Society law, presents its report for the year ending December 31st, 1886.

### MEMBERSHIP.

As shown by the tabular statement hereinafter given, there has been, during the year an addition of 114 to the various grades of Society membership. In this nominal addition of 114 there is 1 former Associate transferred to Member, and 6 former Juniors also transferred to Members; therefore the actual new additions to the Society membership during the year, number 107.

The losses from the Society membership have been 16, being 9 by death, 6 by resignation, and 1 dropped. The number of persons now connected with the Society is 1 019, being greater by 91 than at the end of the previous year.

The actual net increase during the year, and present total in each class of membership, are:

Honorary Members,	increase during year	1	Total.....	9
Corresponding Members,	"	..	" .....	3
Members,	"	59	" .....	760
Associates,	"	11	" .....	44
Juniors,	"	17	" .....	106
		—		922
Fellows not included above, increase	"	3	" .....	57
Subscribers to Building Fund, not included above.....				40
				—
Increase during year.....	91	Total .....	1 019	

Tables showing the classification of membership at the beginning of the year, and the changes during the year, are given at a subsequent part of this report.

### ANNUAL CONVENTION.

The Annual Convention was held at Denver, Colo., in the early part of July. The detailed report of the proceedings at the Convention has been published in the Proceedings for that month. The trip to Denver was made by a special train from New York, joined by addi-

tional cars at various points, and the arrangements were such as to make this long trip, both going and returning, very enjoyable, and really a pleasurable part of the Convention.

The meetings at Denver were well attended, and the discussions were earnest and animated. The trips into and over the mountains were of the greatest interest.

A few suggestions have been made by Members as to a desirable place for the next Convention; these will be submitted to you, and the whole subject is presented for your consideration at this meeting.

#### MEETINGS OF THE SOCIETY.

Nineteen meetings of the Society were held during the year, one of which was the Annual Meeting, held in New York January 20th and 21st, and another the Annual Convention, held at Denver, Colo., July 2d, 3d, 5th and 7th, all the sessions of the Convention, including the business meeting, being counted as one meeting of the Society. Meetings have been held on the first and third Wednesday of each month, except July and August.

Thirteen meetings of the Board of Direction have been held during the year.

Light collations, provided entirely by subscription of Resident Members, have followed the Society meetings, and have given opportunities for conversation which have been appreciated.

#### TRANSACTIONS.

The extent of the publications of the Society is increasing as rapidly as the funds at the disposal of the Board will permit. The number of pages issued in the Transactions and Proceedings of the past year is 1035, which is 276 pages greater than have been issued in any other year in the history of the Society. The Board has continued the course adopted by a former Board, and referred to in the last Annual Report, of devoting by far the larger part of the income of the Society to the publication of its Transactions, and it is believed that a continuance of this course is particularly desirable.

#### THE SOCIETY HOUSE AND BUILDING FUND.

There has been but one contribution to the Building Fund during the year.

#### COMPOUNDING DUES BY A SINGLE PAYMENT.

During the past year two Members have compounded for the payment of future annual non-resident dues by a single payment of two hundred and fifty dollars each; this will add five hundred dollars to the funded securities of the Society.

## FELLOWSHIP FUND.

Three Fellows have been added to the list during the past year, and the Fellowship Fund has been thereby increased four hundred and fifty dollars.

## COMMITTEE ON STANDARD TIME.

This Committee presented reports of progress at the Annual Meeting one year ago, and at the Convention in July last. A report is expected from it at this meeting.

## COMMITTEE TO CONSIDER A PLAN FOR CREATING A LIBRARY FOR JOINT USE.

This Committee presented a report at the Annual Meeting one year ago, and was continued. A report has been asked from it for presentation at this meeting.

## COMMITTEE TO CONSIDER THE PROPER RELATION TO EACH OTHER OF THE SECTIONS OF RAILWAY WHEELS AND RAILS.

This Committee was appointed under a resolution adopted at the Convention of 1885, and afterwards submitted to a letter ballot and adopted by a vote of the Society. The Committee reported progress at the Convention in July last, was continued, and a report from it is expected at this meeting.

## COMMITTEE ON THE COMPRESSIVE STRENGTH OF CEMENTS AND THE COMPRESSION OF MORTARS AND SETTLEMENT OF MASONRY.

This Committee presented a report at the Convention in July last which has been published in the Transactions of the Society. A further report is expected at the present meeting.

## AMENDMENTS TO THE CONSTITUTION AND BY-LAWS.

No amendments to the Constitution have been presented during the year. On April 7th, 1886, an amendment to Section 24, second clause, of the By-Laws, was adopted; the clause now reads as follows:

“If it should appear that for any office a majority of the votes cast was not for one person, the meeting shall proceed to vote by ballot, in the usual way, for such officer, the choice of candidates being limited to the two persons not elected for whom the greatest number of votes had been previously cast for such office. When two or more persons have the highest and an equal number of votes at any election for officers, the Society shall elect the officer from among those having the highest and equal number of votes.”

## THE NORMAN MEDAL.

The Norman Medal for the year 1885 was awarded    Paper No. 300,



Report of Tests of Cement made for the Boston Main Drainage Works, 1878 to 1884, the author being Eliot C. Clarke, M. Am. Soc. C. E.

The Board of Censors to award this medal for the past year will present its report at the present meeting.

#### THE ROWLAND PRIZE.

The Rowland Prize for 1885 was awarded to Paper No. 295, Experiments with New Apparatus on Journal Friction at Low Velocities, the author being A. M. Wellington, M. Am. Soc. C. E.

The Committee to award this prize for the past year will present its report at this meeting.

#### PROPOSED CHANGES IN ORGANIZATION.

At the Convention in July, 1886, the Committee previously appointed to consider changes in the organization of the Society was discharged. At the same Convention a resolution was adopted:

"That this subject be referred to the Board of Direction, with the request that they invite written communications from the Members of the Society, and from the different engineering clubs throughout the country, and that these communications be edited under the direction of the Board, and their substance printed and distributed among the Members of the Society. And that the Board shall make a report at the next Annual Meeting, with such conclusions as they desire to lay before the Society, and with the expectation that a special committee will be appointed at that time."

In accordance with the provisions of this resolution, a circular was issued to all Members of the Society and to the various local engineering organizations, embodying the above resolutions, and inviting written communications in reply. The answers received from Members of the Society up to December 10th, 1886, numbered but six, and, in accordance with the resolution of the Convention, the substance of those answers has been printed and distributed among the Members of the Society. A reply had also been received from the Engineers' Club of St. Louis on the subject, previous to December 10th, which reply was included in the circular issued to Members on that date.

Since December 10th, communications on the subject have been received from five other Members of the Society, and also from the Boston Society of Civil Engineers, and from the Western Society of Engineers at Chicago.

The substance of all the replies received is as follows:

The Engineers' Club of St. Louis has taken the following action: First, "That it does not feel called upon to express an opinion as to any organic change in the American Society of Civil Engineers; and second, that the St. Louis Club would favor a union of publications, provided this could be effected on an impartial and satisfactory basis."

The Boston Society of Civil Engineers has taken the following action: "That such an arrangement as will lead to the joint publication

of the papers of the engineering societies of the United States is very desirable. That a closer union of the American Society and the local societies would be for the benefit of the engineering profession; that this Society would be glad to consider any proposition from the American Society looking toward the accomplishment of these ends."

The Western Society of Civil Engineers has taken the following action:

"*Resolved*, That this Society is in favor of the organization of a National Association of Engineers, and is convinced that the details of such an organization can be most readily and satisfactorily matured by a conference of representatives of the Societies in interest; and

"*Resolved*, That in furtherance of this purpose, this Society is ready at any time to send delegates to confer with those of the American Society of Civil Engineers, and of such other societies as may choose to participate, at such time and place as the American Society may designate.

"*Resolved*, That the Secretary of this Society be instructed to send a copy of these resolutions to the Board of Direction of the American Society of Civil Engineers."

The substance of the replies from the eleven Members of the Society is as follows:

Five oppose at present any organic union with the local societies.

Three favor permissive action for the formation of sections.

Three favor a modification of the present classification of membership.

Six favor some form of joint publications.

One favors a national incorporation for the Society.

One favors making the Secretary of the American Society of Civil Engineers also Secretary of the Board of Managers of the Association of Engineering Societies; leaving the publications separate as they are now.

One favors forming local chapters of the Society, and where local associations now exist would make it possible for the whole body to become a chapter of the Society, but without conferring membership in the Society to any not already Members.

One favors steps to secure a friendly and closer union with the other national societies of engineers.

One favors a National Academy of Engineers.

Under the provisions of the resolution adopted at the last Convention above referred to, the Board reports, as its conclusion, that it is evident that there is at present no desire for changes in the organization of the Society.

#### REGULATIONS CONCERNING THE ADMISSION OF FOREIGN ENGINEERS.

A number of applications have been received from time to time from engineers residing in foreign countries. Accompanying some of the applications are commendations from well-known sources, showing that the applicants are of high standing in their profession. The fact that these applicants are not personally acquainted with five Members of the Society has made it impossible that their applications should have upon them the indorsement of five Members who can certify that they per-

sonally knew the nominee or candidate, and that he is worthy of acceptance. As the indorsement of five Members is a requirement of the Constitution of the Society, the Board has been unable to pass these applications to ballot, even in cases where the evidence of the standing and character of the applicant was of such a character as to admit of no question as to eligibility for membership.

A number of our Members have suggested that some special provision might be made by the Society which would authorize the Board of Direction to act specially in such cases; of course imposing at the same time upon the Board the duty of a thorough examination as to character and standing of each applicant.

## MEMBERSHIP TABLES.

The following tables show the changes and additions during the year in the various classes of membership:

On January 1st, 1886, the date in the last report, the membership in the Society was:

Honorary Members, resident...	2	Non-resident....	6	Total...	8
Corresponding Members.....	—	“	3	“	3
Members, resident.....	131	“	570	“	701
Associates, “ .....	10	“	23	“	33
Juniors, “ .....	23	“	66	“	89
	—		—		823
Making resident.....	166	Non-resident....	668		—
Total.....					834

Fellows, 62, of whom 8 Members are included above, leaving..... 54

Subscribers to the Building Fund, 139, of whom 92 are entered in one or other of the above classes, and 7 deceased, leaving..... 40

Total connected with the Society, January 1st, 1886.....928

At the present date, January 1st, 1887, the membership is :

Honorary Members, resident...	3	Non-resident....	6	Total...	9
Corresponding Members.....	—	“	3	“	3
Members, resident.....	153	“	607	“	760
Associates, “ .....	11	“	33	“	44
Juniors, “ .....	25	“	81	“	106
	—		—		910
Making resident.....	192	“	730		—
Total.....					922

Fellows, 64, of whom 7 Members are included above, leaving..... 57

Subscribers to the Building Fund, 140, of whom 90 are entered in one or other of the above classes, and 10 deceased, leaving..... 40

Total connected with the Society, January 1st, 1887.....1 019

The additions during the past year to the several classes of Society membership have been :

Honorary Member qualified.....	1
Members qualified .....	75
Associates qualified .....	12
Juniors qualified.....	23
Fellows qualified .....	3
<hr/>	
Total additions to the several classes of membership.....	114
Subscriber to the Building Fund, 1, who is otherwise connected with the Society.....	—
<hr/>	
Total additions.....	114

The decrease during the year in the several classes of membership has been:

Members....Died 9   Resigned 6   Dropped 1.....	16
Associate .....	Transferred to Member..... 1
Juniors.....	“                    “                    6

Totals: Deaths 9, Resignations 6, Dropped 1, Transferred 7.. 23

There has been an addition of 114 to the various classes of membership, and a decrease of 23, making the actual net additions during the year 91 in number.

On January 1st, 1886, there was, as stated in the last Annual Report, 21 proposals pending. One hundred and thirty-two proposals have been received during the year; 1 candidate has been elected as Honorary Member; 78 candidates have been elected Members, of whom 1 was transferred from Associate, and 8 were transferred from Juniors; 12 candidates have been elected as Associates; 25 candidates have been elected Juniors; 3 candidates have been elected Fellows.

One person has during the year qualified as Honorary Member; 75 have qualified as Members; 12 have qualified as Associates; 23 have qualified as Juniors; 3 have qualified as Fellows; 6 candidates elected during the year as Members, and 2 as Juniors and 1 as Fellow have not yet qualified. There are 29 proposals now pending.

The Library has been increased during the year by the following additions:

Books and Pamphlets.....	598
Maps, Plans, Drawings, Charts, Photographs and Engravings.....	181

Reports made during the year have been as follows:

By the Board of Direction: The Annual Report.

By the Finance Committee: Annual Report on the Finances of the Society; Quarterly Reports to the Board of Direction.

By the Library Committee: Regular Monthly Reports on the Library and on Publications.

By the Secretary: Monthly Reports to the Board of Direction; Occasional Reports on Current Business.

By the Treasurer: The Annual Report of the Treasurer; Monthly Reports to the Board of Direction.

By the Committee on Uniform Standard Time: Two Reports.

By the Committee on the Compressive Strength of Cements: One Report.

By the Committee to Consider a Plan for Creating a Library for Joint Use: One Report.

By the Nominating Committee: One Report.

By the Committee to Present the Twenty-four o'clock System to Railway Time Convention: One Report, and the Committee discharged.

The Society has lost by death during the term covered by this report nine Members: Messrs. E. S. Chesbrough, Past President of the Society; C. Shaler Smith, Past Director of the Society; Martin Coryell, Walton W. Evans, who was also a Fellow of the Society; Edward A. Flint, Richard M. Hoe, James D. Burr, George H. Elliott and Thomas N. Bailey.

Respectfully submitted,

JOHN BOGART,

*Secretary.*



# REPORT OF THE TREASURER FOR THE YEAR ENDING DECEMBER 31st, 1886.

## RECEIPTS.

Balance on hand December 31st, 1885 ..... \$1 945.75

### Receipts during year :

Entrance Fees..... \$2 740.00

### Current Dues :

From 107 Resident Members.....	\$2 570.00
" 523 Non-resident Members.....	7 602.25
" 7 Resident Associates.....	105.00
" 22 Non-resident Associates.....	205.00
" 27 Resident Juniors.....	352.50
" 62 Non-resident Juniors.....	600.00
	<hr/> \$11 434.75

### Past Dues :

From 8 Resident Members.....	\$225.00
" 45 Non-resident Members.....	826.66
" 1 Resident Associate.....	15.00
" 2 Resident Juniors.....	30.00
" 1 Non-resident Junior.....	10.00
	<hr/> 1 106.66

### Dues for year beginning January 1st, 1887 :

From 33 Resident Members.....	\$825.00
" 89 Non resident Members.....	1,327.50
" 2 Resident Associates.....	30.00
" 6 Non resident Associates.....	60.00
" 4 Resident Juniors.....	60.00
" 12 Non-resident Juniors.....	120.00
	<hr/> 2 422.50
	<hr/> 14 963.91

Sales of Publications..... 1 136.53

Certificates of Membership..... 137.50

Advertisements ..... 262.75

Interest on Fellowship Fund Bonds..... \$480.00

" Savings Bank Deposit ..... 53.80

" Norman Medal Fund Bond..... 70.00

" Rowland Prize Fund Bond..... 60.00

" General Fund stock (Gas)..... 30.00

" General Fund Bonds..... 120.00

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813.80

Fellowship Fees..... 450.00

Subscription to Building Fund..... 100.00

Compounding Payments..... 500.00

Other sources..... 1.87

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21 106.36

Balance of Proceeds from Transfer of Securities..... 62.50

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\$23 114.61

## DISBURSEMENTS.

Interest on Mortgage.....	\$800.00	
Taxes.....	499.24	
Publications.....	8 362.41	
Stationery and Printing.....	841.05	
Postage.....	1 002.27	
Library.....	797.33	
Salaries.....	3 000.00	
Convention and Annual Meeting.....	636.64	
Janitor, House Supplies, Fuel, Water and Gas.....	1 337.66	
Certificates of Membership.....	97.50	
Insurance.....	44.63	
Norman Medal and Rowland Prize.....	120.50	
Finance—Treasurer's Books.....	645.00	
Work of Committees.....	518.55	
Other expenditures.....	357.51	
	<hr/>	\$19 060.29
Transferred to Savings Bank.....		116.30
Balance on hand:		
Building Fund.....	\$100.00	
General Funds.....	3 838.02	
	<hr/>	3 938.02

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\$23,114.61

The funds of the Society are as follows:

Fellowship Fund:

Eighty-eight subscriptions to December 31, 1885.....	\$9 350.00
Premium and accumulated interest December 31, 1885.....	1 388.28
	<hr/>
Fund on hand December 31, 1885.....	\$10 738.28
Three subscriptions during 1886.....	450.00
Interest received during 1886.....	533.80
	<hr/>
	\$11 722.08
Expended for publications during 1886.....	533.80
	<hr/>
	<u>\$11 188.28</u>

The present investment of the Fund is:

Eight Pennsylvania Railroad General Mortgage Six per cent. Bonds, cost.....	\$9 889.32
Portion of one Pennsylvania General Mortgage Six per cent. Bond (the other portion in Compounding Fund), cost.....	722.50
Portion of deposit in Seamen's Bank for Savings .....	576.46
	<hr/>
	<u>\$11 188.28</u>

Norman Medal Fund:

One Certificate Croton Aqueduct Stock, New York City .....	\$1 000.00
	<hr/>

Building Fund :

Receipts previous to December 31, 1885.....	\$17 742.00
“ during 1886.....	100.00
	<hr/>
	<u>\$17 842.00</u>

Expended :

For Legal Services, Circulars, etc.....	\$355.03
For Improvements on Property.....	3 386.97
Payments on Purchase.....	14 000 00
Cash on hand.....	100.00
	<hr/>
	<u>\$17 842.00</u>

## Rowland Prize Fund:

One Pennsylvania Railroad General Mortgage Six per cent. Bond, cost.....	\$1 222.50
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## General Investment :

Ten Shares Stock Consolidated Gas Company of New York, cost.....	\$972.50
One Pennsylvania Railroad General Mortgage Six per cent. Bond, cost.....	1 222.50
Portion of deposit in Seamen's Bank for Savings.....	388.80
	<u>\$2,583.80</u>

## Compounding Fund:

Two single payments for compounding dues.....	\$500.00
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## The present investment of this Fund is:

Portion of one Pennsylvania Railroad Six per cent. General Mortgage Bond.....	500.00
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Respectfully submitted,

J. JAMES R. CROES,  
Treasurer.

## REPORT OF THE COMMITTEE ON FINANCE.

New York, January 18th, 1887.

The Finance Committee have the honor to report that they have performed the usual duty of auditing all the bills which have been paid by the Treasurer during the past year, and have found that each bill has been charged to its proper fund, and that the several sums have not exceeded the amounts appropriated by the Board of Direction for the purposes specifically mentioned. Also that the Committee has, at the end of the year, carefully examined all the assets of the Society, and has found that the reports of the Secretary and Treasurer give a correct account of the same.

G. S. GREENE, JR.,	} Finance Committee.
W. HOWARD WHITE,	
HENRY G. MORRIS,	

# LIST OF PUBLICATIONS AND PAPERS RECEIVED FOR LIBRARY.

APPENDIX TO ANNUAL REPORT OF THE BOARD OF DIRECTION,  
JANUARY 19TH, 1887.

The following papers are contributed to the Society, or are received  
in exchange for Transactions:

American Architect and Building News.....	Weekly.....	Boston.
American Engineer.....	".....	Chicago.
American Gas Light Journal.....	Semi-Monthly.....	New York.
Annales des Travaux Publics.....	Monthly.....	Paris.
Army and Navy Journal.....	Weekly.....	New York.
Builder.....	".....	London.
Building.....	".....	New York.
Building News and Engineering Journal.....	".....	London.
Bulletin American Iron and Steel Association.....	Semi-Monthly.....	Philadelphia.
Bulletin du Canal Interocéanique.....	" ".....	Paris.
Commissioner of Patents' Journal.....	Semi-Weekly.....	London.
Der Civilingenieur.....	Monthly.....	Leipsig.
Deutsche Bauzeitung.....	Weekly.....	Berlin.
Eizen Zeitung.....	".....	Vienna.
Electrical Review.....	".....	New York.
Engineer.....	".....	London.
Engineering.....	".....	"
Engineering Era.....	Semi-Monthly.....	Cleveland.
Engineering and Mining Journal.....	Weekly.....	New York.
Engineering News and American Contract Journal.....	".....	"
Genie Civil.....	Semi-Monthly.....	Paris.
Indian Engineer.....	" ".....	Calcutta.
International Standard.....	Quarterly.....	Cleveland.
Iron.....	Weekly.....	London.
Iron Age.....	".....	New York.
Journal of the Association of Engineering Societies.....	Monthly.....	"
Journal of Society of Arts.....	Weekly.....	London.
Journal of Gas Lighting.....	".....	"
Locomotive.....	Monthly.....	Hartford.
Machinery Exporter.....	Weekly.....	London.
Machinery Market.....	".....	"
Manufacturer and Builder.....	Monthly.....	New York.
Manufacturer and Iron World.....	Weekly.....	Pittsburgh.
Magazine of American History.....	Monthly.....	New York.
Mechanical News.....	Semi-Monthly.....	"
Norsk Teknisk Tidsskrift.....	Monthly.....	Christiania.
Nouvelles Annales de la Construction.....	".....	Paris.
Portefeuille Economique des Machines.....	".....	"
Record of Scientific Literature.....	".....	New York.
Railroad Gazette.....	Weekly.....	"
Railway Age.....	".....	Chicago.
Railway News.....	Monthly.....	New York.
Railway Review.....	Weekly.....	Chicago.
Railway World.....	".....	Philadelphia.
Reportorium der Technischen Literatur.....	".....	Leipsig.
Revue Générale des Chemins de fer.....	Monthly.....	Paris.



Sanitary Engineer.....	Weekly.....	New York.
Scientific American.....	“ .....	“
Scientific American Supplement.....	“ .....	“
Teknisk Tidsskrift.....	Monthly .....	Stockholm.
Techniker.....	Semi-Monthly..	New York.
Telegraph Journal and Electric Review.....	“ .....	London.
The American Railroad Journal.....	Monthly .....	New York.
The Mechanical World.....	Weekly.....	Manchester.
Van Nostrand's Magazine.....	Monthly .....	New York.
Zeitschrift für Bauwesens.....	Quarterly .....	Berlin.

The following are subscribed for :

American Bookseller.....	Semi-Monthly..	New York.
American Library Journal.....	Monthly.....	“
Publishers' Weekly.....	Weekly.....	“
Science .....	“ .....	Cambridge.
U. S. Official Postal Guide.....	Monthly .....	Boston.

The Society has received during the year, in exchange for the Transactions, official publications of the following associations, in many instances for preceding years:

Aeronautical Society of Great Britain.....	London.
Academy of Sciences.....	Washington.
Akademie des Bauwesens.....	Berlin.
American Institute of Architects.....	New York.
American Institute of Electrical Engineers.....	“
American Institute of Mining Engineers.....	“
American Iron and Steel Association.....	Philadelphia.
American Society of Mechanical Engineers.....	New York.
Annales de Construcciones Civiles y de Minas.....	Lima.
Annales des Ponts et Chaussées.....	Paris.
Argentine Scientific Society.....	Buenos Ayres.
Association of Civil Engineers.....	Lisbon.
Astor Library.....	New York.
Austrian Society of Engineers and Architects (Two Publications).....	Vienna.
Boston Public Library.....	Boston.
Boston Society of Civil Engineers.....	“
California Academy of Sciences.....	Sacramento.
Canadian Institute.....	Toronto.
Civil Engineers' Society of St. Paul.....	St. Paul.
Civil Engineers' Club of Cleveland.....	Cleveland.
Colegio N. Rosales.....	Culiacan, Mexico.
Die Administration der “ Mittheilungen ”.....	Vienna.
Engineer Department, U. S. A.....	Washington.
Engineers' Club of Philadelphia.....	Philadelphia.
Engineers' Club of St. Louis.....	St. Louis.
Engineers' Society, Western Pennsylvania.....	Pittsburgh.
Franklin Institute Journal.....	Philadelphia.
Imperial Hochschule.....	Berlin.
Imperial School.....	Moscow.
Imperial Technic Society of Russia.....	St. Petersburg.
Imperial University.....	Tokio.
Institution of Civil Engineers.....	London.
Institution of Civil Engineers of Ireland.....	Dublin.
Institution of Engineers and Shipbuilders of Scotland.....	Glasgow.
Institution of Mechanical Engineers.....	London.
Iron and Steel Institute.....	“

Library of Parliament.....	Ottawa.
Liverpool Engineering Society.....	Liverpool.
Massachusetts Institute of Technology.....	Boston.
McGill University, Department of Science.....	Montreal.
Mechanics' Institute.....	San Francisco.
Midland Institute Mining, Civil and Mechanical Engineers.....	Barnsley, Eng.
Military Service Institution of the United States.....	Governor's Isld., N.Y.
Mining Institute of Scotland.....	Hamilton.
National Railway Publishing Co.....	New York.
New York Meteorological Observatory.....	New York.
North of England Institute of Mining and Mechanical Engineers.....	Newcastle-on-Tyne.
Rensselaer Society of Engineers.....	Troy.
Riga Technical Society.....	Riga.
Royal United Service Institution.....	London.
School of Mines, Columbia College.....	New York.
Seismological Society of Japan.....	Tokio.
Smithsonian Institution.....	Washington.
Society of Arts.....	London.
Society of Civil Engineers.....	Paris.
Society of Engineers.....	London.
Society of Engineers and Architects.....	Cologne.
Society of Engineers and Architects.....	Hannover.
Society of Engineers and Architects of Hungary.....	Budapest.
Society of Engineers and Architects of Saxony.....	Dresden.
Stevens Institute of Technology.....	Hoboken.
Swedish Society of Engineers.....	Stockholm.
Technical Society of the Pacific Coast.....	San Francisco.
Technischen Hochschule.....	Aachen.
Technischen Hochschule.....	Hannover.
Thayer Scientific School, Dartmouth College.....	Hanover.
United States Agricultural Department (Division of Forestry).....	Washington.
United States Coast and Geodetic Survey.....	"
United States Geological Survey.....	"
United States Light-house Board.....	"
United States Naval Institute.....	Annapolis.
United States Naval Observatory.....	Washington.
United States Ordnance Department.....	"
United States Patent Office.....	"
University of Michigan.....	Ann Arbor.
Verein Deutscher Ingenieure.....	Berlin.
Western Society of Engineers.....	Chicago.

# ADDITIONS TO LIBRARY AND MUSEUM.

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## DOCUMENTS ON WEIGHTS AND MEASURES.

FROM FRED. BROOKS, M. AM. SOC. C. E., BOSTON, MASS.:

- A New Decimal Metrical System, founded on the Earth's Polar Diameter, and designed for adoption by all civilized nations as the one common system. W. Wilberforce Mann, New York and Baltimore, 1872.
- Weights and Measures. Report by the Board of Trade, presented pursuant to Act of Parliament in the House of Commons, July 28, 1885, on their Proceedings and Business under the Weights and Measures Act, 1878.
- The Universal Metric System, prepared especially for candidates for Schools of Science, Engineers and others. Alfred Colin, M.E., New York, 1876.
- The Metric System. A compilation consisting of Extracts from the Report of the Committee of the House of Representatives, and the Law of Congress adopting the system, and Tables of Authorized Weights and Measures; and a translation of a portion of a work entitled "The Legal System of Weights and Measures," by M. Lamotte, Philadelphia, 1867.
- A Decimal System of Weights and Measures for the English-speaking Nations. A Report (46th Congress, 2d Session, Mis. Doc. No. 29) from the Committee on Coinage, Weights and Measures, on a Decimal System of Weights and Measures, as proposed by Colonel Thos. S. Sedgwick, and a reply of C. P. Culver advocating the French Metric System.
- The Metric System of Weights and Measures. J. Pickering Putnam, New York and Cambridge, 1874.
- The Metric System of Weights and Measures. Speech of Hon. Charles Sumner in the Senate of the United States, July 17, 1866, Boston, 1866.
- What shall we do with the Metric System? Professor R. B. Warder. *Ohio Educational Monthly*.
- The Metric System in Medicine. Frederic Henry Gerrish, M. D. *Transactions Maine Medical Association*, 1878.
- The Use of Metrical Weights in Prescriptions. Professor John M. Maisch. *American Journal of Pharmacy*, October, 1876.
- The Metric System in Medicine and Pharmacy. T. B. Curtis, M. D., Cambridge, 1877.
- On the French Metric System of Weights and Measures, with Objections to its Adoption among English-speaking Nations, and on the Duodenal Arithmetic and Metrology. John W. Nystrom, C. E., Philadelphia, 1876.
- Simplified Weights and Measures, on a natural system applicable to most civilized nations. Louis D. A. Jackson, A. I. C. E., London and New York, 1876.
- Unification of Moneys, Weights and Measures. Alfred B. Taylor, New York, 1882.
- Shall the Metric System be made Compulsory? Henry T. Blake. *The New Englander*, September, 1879.
- United States Decimal System of Weights and Measures, having the Pound remaining the same as it is at present in Avoirdupois Weight, and the foot the same as it is at present in Long Measure. Henry Vroman, Modesto, Cal., 1876.
- Boston Society of Civil Engineers. Papers read at a Special Meeting held March 3, 1886:
- (1.) Comparative Size of Metric and Old Units with reference to convenience. Fred. Brooks, Member of the Society.
  - (2.) Report of Committee on Weights and Measures. Charles H. Swan, C. W. Folso and C. W. Kettell.
- American Association for the Advancement of Science. Detroit Meeting, 1875. Report of the Committee on Weights, Measures and Coinage.

## MEMOIRS OF DECEASED MEMBERS.

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ANTHONY WALTON WHYTE EVANS, M. Am. Soc. C. E.

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DIED NOVEMBER 28TH, 1886.

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Anthony Walton Whyte Evans, the eldest son of Thomas Evans, of Virginia, was born at New Brunswick, New Jersey, October 1st, 1817. His grandfather on the maternal side was General Anthony Walton Whyte, of revolutionary fame, who at a critical period of the war procured upon his own personal credit the funds necessary to remount and support for a short time two regiments of cavalry, a branch of the army in which he held a high command and did distinguished service.

Mr. Evans received his preliminary education in the schools of New Jersey, but having fixed his thoughts on civil engineering as his future profession, he entered the Rensselaer Polytechnic School at Troy, in the State of New York, from which he graduated in 1836, being at the time of his death, with one exception, the oldest living graduate of that institution.

His earliest professional employment was upon the enlargement of the Erie Canal one of the great works of its day, which a short time before had been commenced by the State of New York. He performed some service on the central division, but was at an early date assigned to duty near Albany on the eastern division of the canal, of which John B. Jervis and William J. McAlpine were successively the Chief Engineers. Here he acquired a practical knowledge of hydraulic engineering and of works of masonry, which was of much value to him through his professional life.

In 1845 he was appointed by Mr. Allan Campbell, one of his assistants in the survey and construction of the New York and Harlem Railroad, and for five years discharged with credit and ability the duties of Resident Engineer of two divisions of that work.

About the year 1849 some of the States of South America, which so long had been torn and distracted by rebellion and revolutions, began to consider the advantages of railroads, not only as promoters of industry and commerce, but as conservators of union within their own borders and of peace with neighboring countries.

One of the earliest of these was the Republic of Chili, and it is gratifying to know that a citizen of the United States, Mr. William Wheel-

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Committee to prepare memoir: Allan Campbell, William J. McAlpine, and John Bogart.

wright, was the moving spirit in initiating these works of internal improvement in the southern continent of America. He had already, by his energy and zeal, and the confidence reposed in him by the government of Chili and foreign capitalists, established a line of steamships between Panama and Valparaiso. The great advantages of these coast-wise steamers encouraged Mr. Wheelwright to recommend the construction of a railroad in Chili from the Bay of Caldera to the inland city of Copiapo, a distance of fifty miles, which was ultimately extended fifty miles further to the silver mines of Chanarcillo. Accordingly a company was formed, under a grant from the government, and Mr. Wheelwright was made its Managing Director, with ample powers to carry out the projected enterprise. His desire was to commence these new improvements according to the plans and methods adopted in the United States, where railroads had been successfully and economically constructed; such system being, in his opinion, most in accordance with the topography of the country and its financial resources.

Mr. Campbell having been appointed Chief Engineer of the Copiapo Railroad, Mr. Evans accompanied him to Chili as one of his principal assistants.

It is a coincidence worthy of mention, that on the same steamer which conveyed the corps of American engineers from Panama to Chili, was also a corps of English engineers destined for Peru to build a railroad from Callao to Lima. Thus the people of England and the United States were simultaneously employed in the very commencement of those improvements which have resulted in such signal benefit to South America, and which were in fact the first works of the kind undertaken in the southern hemisphere.

After the location and commencement of the construction of the Copiapo Railroad, the Chief Engineer being called by the government of Chili to another railroad, Mr. Evans remained as Resident Engineer until its completion.

The successful opening and operation of this work, and its extraordinary financial results, gave an impetus to the construction of railroads not only in Chili, but in other States upon the Pacific Coast, and to those vast countries lying east of the Andes, the Argentine Republic and the Brazilian Empire. It was considered just cause for congratulation that this pioneer work in the railroad system of a continent had been constructed and equipped upon the American system, and Mr. Wheelwright, its projector, received great credit for his foresight in this respect.

The Callao and Lima Railroad having been completed, the Peruvian government conceded to certain capitalists the right to construct a railroad from Arica on the sea coast, to the inland city of Tacua, a distance of thirty miles. Of this road Mr. Evans was appointed Chief-Engineer, and brought it to an early and successful completion.



After visiting his native country he returned to Chili and entered upon the construction of a railroad leading from Santiago to the southern provinces of the republic, being a continuation of the great railroad from Valparaiso to Santiago. On this line several large rivers are crossed, which, having their sources in the Andes, sweep down at certain seasons with extreme velocity, requiring bridges of great strength and stability in their foundations.

Mr. Evans now returned to the United States, and henceforth pursued his profession as consulting engineer, and as purchasing agent of rolling stock and other railway materials for various governments and companies of South America and the islands of the Southern Ocean. He established his home at New Rochelle, near the City of New York, where he reared his family, and entertained with hospitality professional friends of his own country, as well as many distinguished engineers of foreign lands. Here also he collected a library of professional and miscellaneous works of exceptional value and usefulness.

Besides his several journeys to the Pacific Coast, he traveled through Great Britain and the Continent of Europe and into Egypt, examining with care and interest the great works of antiquity, as well as those of modern civilization. During these travels he collected many rare books, pictures and other works of art, which adorn his library and gallery at New Rochelle.

The government of Peru entered largely into contract with Henry Meigs, an American citizen, for the construction of railways in that country, some of which extended to the very heart of the Andes, and to heights greater than any yet attained in railroad building. Mr. Evans was the consulting engineer, and designed, amongst other works, the Varrugas viaduct on the Lima and Oroya Railway, an iron structure 8 000 feet above tide, of three spans 580 feet long, and 300 feet above the bed of the valley.

Either as consulting and inspecting engineer or purchasing agent, Mr. Evans was connected with many foreign governments and corporations, as will appear by the following list, furnished by Mr. Joseph S. Spinney, a merchant of New York, who for many years has been connected with him as shipping agent:

Arica and Tacua Railway Company .....	Peru
Arequipa Street Railway Company .....	Peru
Cerro de Pasco Railway .....	Govt. of Peru
Central Argentine Railway Company .....	Argentine Republic
Chilian, Concepcion and Tulcahuana Railway .....	Govt. of Chili
Curico and Angol Railway .....	"
Chanaral Railway .....	English Company
Coquimbo Railway .....	"
Eten Railway .....	"
Antofagasta Railway .....	"
Lima and Huacho Railway .....	"

Mijia and Arequipa Railway.....	Govt. of Peru
Mexican Railway.....	English Company
New Zealand Railways.....	Government
Pisco and Yca Railway.....	Company, Peru
Patillos Railway.....	“ “
Pimental and Chiclayo Railway.....	“ “
Rakaia and Ashburton Forks Railway.....	New Zealand Govt.
Southern Railway of Chili.....	Chili Govt.
Santiago and Curico Railway.....	“
Santiago and Talca Railway.....	“
Santiago Street Railway.....	Company
South Australian Government Railways.....	
Tongoy Railway Company.....	Chili
Urban Railway of Valparaiso.....	Company, Chili
Victorian Railways.....	Govt. of Victoria
Wellington and Manawata Railway.....	Govt. of New Zealand
Costa Rica Railway.....	Govt. of Costa Rica
Nicaragua Railway.....	Govt. of Nicaragua

To these distant countries was exported from the manufactories of the United States, railway materials and rolling stock amounting to many millions of dollars in value. Mr. Spinney says: “For most of these roads he ordered and shipped everything but rails; the engines, cars, bridges, tools, buildings, etc., were of his own selection, and built on his specifications. No complaint was ever made of work furnished by him, and from some of his constituents orders have been coming for twenty-five years.”

Mr. Evans was a staunch defender of the superiority of American rolling stock over that of all other countries, and by the practical demonstration of the truth of his opinion, it is not too much to say that he has been instrumental during his lifetime in introducing our locomotive engines and cars to many foreign countries, including British provinces, the benefits of which are destined to increase with the extension of the railway system in those vast and rapidly growing countries.

Mr. Evans took great interest in the matter of a ship canal between the Atlantic and Pacific Oceans, and has given his views very fully upon this subject in the papers of this Society, as well as in other documents. Like most of the engineers of this country who have investigated the problem, he held decided opinions against the practicability of the Panama route, declaring it to be objectionable physically by reason of the vast drainage of the line traversed, and financially because of its enormous and incalculable cost of construction and maintenance even if ever carried to final completion; a result which he could not have anticipated, for he adds, “I look on the Panama route for a sea-level canal as simply ridiculous.”

While not condemning as impracticable the Nicaragua route, he claimed that in addition to the lockage it has other serious defects. His preference was for a sea-level canal by the San Blas route, from the Gulf of San Blas on the Atlantic coast, to the Bay of Panama on the Pa-

cific side. On this line, of only thirty miles in length, he maintained that a sea-level canal could be constructed which would be unaffected by floods of contiguous or intersecting streams, with safe and commodious harbors on both oceans; its only objectionable feature being a tunnel, about ten miles long, sufficiently high for masted vessels. This, in view of the improved method of tunneling, both in economy and dispatch, he did not regard as insuperable when contrasted with the many favorable features of the route in all other respects. In his paper, published in the proceedings of this Society, he estimated the cost of the work at \$138,000,000; and after a full and vigorous defense of the project adds, "It is, in my eyes, a sure thing that a great world's canal will some day be cut on the San Blas route." He also addressed to the United States Government a memorial on the interoceanic canal question, and in advocacy of the San Blas route.

Mr. Evans contributed several papers on important subjects to the American Society of Civil Engineers. Besides that already mentioned in regard to an interoceanic canal, was one upon the project of enlarging the Erie Canal. He boldly supported the proposition to make it "a ship canal equal in carrying capacity to the new Welland Canal" with a branch canal of equal capacity from the main line to Lake Ontario. He says: "If New York City is to maintain its supremacy as the Empire City of this continent, it must do all in its power to improve and make more powerful its water lines."

One of his latest papers was an elaborate review of the Abt system of railway for steep inclines, and his very latest, not published till after his death, is an interesting paper on "English and American Railroads Compared." He also published in magazines and in pamphlet form numerous articles on subjects connected with his profession, as well as some of a miscellaneous character. Of the latter class is an interesting memoir of Kosciuszko, prepared for the Society of the Cincinnati, but published by himself in a separate volume, beautifully illustrated for private distribution.

Several years ago Mr. Evans furnished to the Colonial Government of New Zealand an interesting paper on the "Preservation of Timber," and another, at the request of the Hon. Mr. Childers, an English statesman, on the question of "Railway Gauges for the British Colonies," in which he strongly defends the superiority of the standard gauge of four feet eight and a half inches.

In later years he condemns without qualification the "narrow gauge" system which has recently obtained to a limited extent in this and other countries.

Mr. Evans was a Member and Fellow of the American Society of Civil Engineers, of the American Geographical Society, and of the Numismatic and Antiquarian Society of Philadelphia. He was also elected several years ago a Member of the British Institution of Civil Engineers.

A few months before his death, he was requested by the government of New South Wales to serve upon a commission of engineers appointed to examine and report upon the plans of the Hawkesbury Bridge, a structure of vast dimensions and of serious engineering difficulties. He was compelled however by the condition of his health to decline the appointment. This great Australian bridge is now in process of erection by the Union Bridge Company of this city, some of whose Directors are Members of this Society. He was also, by virtue of his descent from General Whyte, a member of the Society of the Cincinnati, and served for several years upon one of its most important committees.

Mr. Evans had extensive intercourse, both in person and by correspondence, with engineers, inventors and business men of his own and of foreign countries. Though conservative in his views, and painstaking in investigation, he was always ready to adopt improvements; and to inventors, says a friend, "he listened carefully, examined faithfully, and if he saw merit, helped where help was needed."

Mr. Evans married Miss Zimmerman, an estimable and accomplished lady of this city, the daughter of John C. Zimmerman, who for many years was Consul-General of Holland at the City of New York. His wife and two sons preceded him to the grave, leaving him his only daughter, who has been his constant companion in his travels, and his devoted and faithful attendant up to the hour of final separation. He suffered for many years from asthma, but manfully continued his labors to within a short time of his death. He spent a few of the last weeks of his life in Washington for the benefit of his health, and had intended to visit Europe for the same purpose, but becoming much enfeebled he returned to New York, where he died November 28th, 1886.

In concluding this brief sketch of Mr. Evans' career, it can with great truth be said that his life was one of eminent usefulness, and that he leaves a record and name which entitle him to rank with the distinguished civil engineers of this country.

Mr. Evans was elected a Member of the American Society of Civil Engineers December 4th, 1867, and a Fellow of the Society March 15th, 1870.

## THE NORMAN MEDAL.

## CODE OF RULES FOR ITS AWARD.

I.—Competition for the Norman Medal of the American Society of Civil Engineers shall be restricted to Members of the Society.

II.—There shall be one gold medal, and only one, struck for each and every fiscal year of the Society, and awarded as hereinafter provided. The dies therefor shall be with the Superintendent of the United States Mint at Philadelphia, in trust exclusively for the above purpose. Such medal shall be of a cost equal to the annual interest received upon \$1 000 of the Consolidated Stock of the City of New York, Certificate No. 179, of the additional new Croton Aqueduct Stock of the City of New York, authorized by an Act of the Legislature of the State of New York, Chap. 230, passed April 15th, 1870, dated November 17th, 1873, now held in trust by the Treasurer of this Society, and so held solely for this purpose, and shall be executed upon his order.

III.—All original papers presented to the Society by Members of any class, during the year for which the medal is awarded, shall be open to the award, provided that such papers shall not have been previously contributed in whole or in part to any other association, nor have appeared in print prior to their publication by the Society, nor have been presented to the Society in any previous year.

IV.—The Board of Censors to award the medal shall consist of three Members of the Society, to be designated by the Board of Direction. The Secretary of the Society shall act as Secretary to the Board of Censors.

V.—The medal shall be awarded to such paper as the said Board shall judge to be worthy of special commendation for its merits as a contribution to engineering science, not merely relatively as compared with others presented during the same year, but as exhibiting the science, talent or industry displayed in the consideration of the subject treated of, and for the good which may be expected to result from the discussion and the inquiry.

VI.—In case no paper presented during the year shall be deemed of sufficient value to receive an award, the amount of the interest of the fund for that year shall be expended by the Board of Direction in the purchase of books, to be offered as a premium for the second best paper in the next year in which more than one paper of sufficient value may be presented.

VII.—The medal year shall terminate on the first day of August, and the award shall be announced at the annual meeting.

VIII.—The Treasurer of this Society shall cause the medal to be prepared and delivered to, or deposited to the order of, the successful competitor, within two months after the annual meeting at which the same shall have been awarded.



## THE ROWLAND PRIZE.

### CODE OF RULES FOR ITS AWARD.

Not more than one prize shall be awarded each year for papers presented during the year. The year shall terminate on the first day of August, and the award shall be announced at the annual meeting in January.

The prize shall consist of fifty dollars in cash.

The award shall be made by a committee consisting of the Secretary and two Members of the Society, to be appointed by the Board of Direction.

The prize shall be awarded to such paper as the committee deem most worthy of such recognition, the preference being given to papers describing in detail accomplished works of construction, their cost and manner of execution, and the errors in design and execution.

### LIST OF MEMBERS.

#### ADDITIONS.

MEMBERS.	Date of Election.
CONNOR, ADDISON.....	Nebraska City, Neb.....Jan. 5, 1887.
SCHAUB, JULIUS WILLIAM.....	(Elected Junior Nov. 5, 1884), Engineer in Charge Dominion Bridge Co., Montreal, Canada.....Oct. 6, 1886.
WHITNEY, FRANK ORMOND....	(Elected Junior May 3, 1876), City Hall, Boston, Mass....Jan. 5, 1887.

#### JUNIORS.

CLARKSON, ROBERT COOKE.....	(Care Wilson Bros. & Co.), 435 Chestnut street, Philadelphia, Pa .....Jan. 5, 1887.
HODGE, HENRY WILSON.....	(Care Phoenix Bridge Co.), Phoenixville, Pa. ....Jan. 5, 1887.

## CHANGES AND CORRECTIONS.

## MEMBERS.

ATWOOD, WILLIAM H.....	(Care Toledo, St. Louis and Kansas City R. R.), Toledo, Ohio.
BAKER, WILLIAM H.....	Mobeetie, Texas.
BATES, ONWARD.....	317 Olive street, St. Louis, Mo.
BRYSON, ANDREW.....	(Shunk & Bryson), 1 Broadway, Room 106, New York City.
COLTON, OREN B.....	Superintendent Fort Worth and Rio Grande Ry., Fort Worth, Texas.
DOANE, EDWIN A.....	Resident Engineer Georgia Division East Tennessee, Virginia and Georgia Ry., 225 Forsythe street, Atlanta, Ga.
FTELEY, ALPHONSE.....	Consulting Engineer Aqueduct Commission, Room 215, Stewart Building, New York City.
GREENE, BENJAMIN D.....	P. O. Box 95, Savannah, Ga.
OPDYKE, STACY B., Jr.....	1 Lambertson street, New Haven, Conn.
ROWE, SAMUEL M.....	Resident Engineer Atlantic and Pacific R. R., Albuquerque, N. M.
RUDLOFF, HENRY F.....	(Care U. S. Legation), Caracas, Venezuela.
SAMPLE, JOHN H.....	Lock Box 184, Gainesville, Fla.
WARD, CHARLES D.....	Oswego Indurated Fibre Co., Oswego, N. Y.

## JUNIORS.

BARLOW, JOHN Q.....	Division Engineer Union Pacific R. R., Omaha, Neb.
STARR, WILLIAM H.....	Superintendent Rochester Division New York, Lake Erie and Western R. R., Rochester, N. Y.
WADDELL, MONTGOMERY.....	Electric Machine Co., Schenectady, N. Y.

## DEATHS.

DERBISHIRE, STEWART.....	Elected Member April 2d, 1884; died January 2d, 1887.
HASLETT, SULLIVAN.....	Elected Member June 4th, 1879; died January 4th, 1887.

# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII.—February, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

FEBRUARY 2D, 1887.—The Society met at 20 o'clock, President Worthen in the Chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates declared elected: As Members, Charles Ackenheil, Elizabeth, N. J.; George Meade Bond, Hartford, Conn.; John William Ferguson, elected Junior February 2d, 1881, New York City; Alexander Mackenzie, Rock Island, Ill.; John Willison Rutherford, New York City; George Huntington Thomson, Sing Sing, N. Y.; Samuel Tobias Wagner, Phoenixville, Pa.; Robert Edward Williams, Jackson, Mich.; Charles Pope Yeatman, Cincinnati, Ohio. As Juniors: Edwin Duryea, Jr., Rulo, Neb.; Corydon Tyler Purdy, Eau Claire, Wis.; Emanuel Schoney, Brooklyn, N. Y.

Communications on the subject of Irrigation from George G. Anderson, Engineer Platte Land Company, Denver, Colo., and E. E. R. Tratman, Junior Am. Soc. C. E., were read, and the subject discussed.

A discussion from J. A. L. Waddell, M. Am. Soc. C. E., on the paper by Joseph M. Wilson, M. Am. Soc. C. E., on Specifications for Strength of Iron Bridges was read, and the subject discussed.

FEBRUARY 16TH, 1887.—The Society met at 20 o'clock, President Worthen in the Chair; John Bogart, Secretary.

The death, on February 7th, 1887, of Mr. William W. Wilson, M. Am. Soc. C. E., was announced.

A jar of specimens of *Teredo Navalis* was exhibited. These had been taken from timber in Pensacola Bay, and sent to the Society by F. W. Vaughan, M. Am. Soc. C. E.

A paper by William H. Grant, M. Am. Soc. C. E., on the Calcula-

tion of the Mean Horse Power of a Variable Stream, and the Cost of Replacing the Power Lost by a Partial Diversion of the Flow, was read, and discussed by Messrs. North, Emery, Worthen, Joseph P. Davis, R. L. Harris, and the author.

#### OF THE BOARD OF DIRECTION.

FEBRUARY 23D, 1887.—Applications were considered. Appropriations made and financial business transacted.

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### MEMOIRS OF DECEASED MEMBERS.

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#### WILLIAM WILLARD WILSON, M. Am. Soc. C. E.

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DIED FEBRUARY 7TH, 1887.

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William Willard Wilson was born in New York City in April, 1841; his father was a successful physician here for several years, and in 1857 moved to Havana, Cuba, where he spent the remainder of his life.

W. W. Wilson received an excellent education in Havana, and in 1859 began his work in the profession of civil engineer as an assistant upon the Havana Railroad, and served upon that railway in various capacities continuously until the latter part of 1862, on the location of about seventy miles of line and construction of forty miles of pretty heavy work, and also in the maintenance and reconstruction of seventy miles of railway previously built. In December, 1862, he was appointed First Assistant Engineer of the Vera Cruz and Orizabo Railroad in Mexico. In March, 1863, he was appointed Engineer in Charge of the construction of the same railway in place of the chief who had resigned, and served in this capacity until the latter part of 1864, giving, at the same time, much attention to the question of the water supply in the dry district. In about eighteen months this office became vacant by the organization of the Imperial Railway Company, with which he served under its various changes and management until May, 1867, as Resident and Division Engineer. In May, 1867, on account of the collapse of the empire, and the consequent disorganization of business affairs, he left the service of the railroad company and served on an expedition to

the west coast of Mexico to examine and devise a plan for the redemption, by drainage, of a large area of submerged land for the sanitary condition of the neighboring City of Tepic. In August, 1867, he returned to the United States and was appointed Engineer in Charge for the location of Central Park Avenue in Westchester County in New York, under Colonel M. O. Davidson, M. Am. Soc. C. E., Chief Engineer, with whom he had also served in Cuba. In 1868, after completing the Central Park Avenue, he was made Principal Assistant Engineer on the construction of the New Haven and Derby Railroad. In 1870 he was principal assistant on the location and construction of the Midland, Yonkers, Highland and Mosholu Railroad in Westchester County, continuing to act as such until the death of his chief, M. O. Davidson, in 1872. He was then made Chief Engineer of the same work, and served in that capacity until the end of 1873, being meanwhile engaged in bridges, streets and sewer work for the City of Yonkers. Early in 1874 he was appointed Chief Engineer of the Yonkers Water-works, and planned them as well as carried them to completion, preparing also the system under which they are operated. In 1877 he was made Engineer and Superintendent of the works, and was also the General City Engineer of the City of Yonkers.

The cost of the public works designed and built by him between 1872 and 1887, was approximately as follows:

Water-works .....	\$795 000
Sewers.....	80 000
Streets and bridges.....	50 000
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	\$925 000

Mr. Wilson became a Member of the American Society of Civil Engineers on January 5th, 1870, and remained a Member until his death on February 7th, 1887. He was buried in Woodlawn Cemetery, New York.

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## LIST OF MEMBERS.

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### ADDITIONS.

MEMBERS.	Date of Election.
ACKENHEIL, CHARLES.....	Chief Engineer New York Extension Baltimore and Ohio R. R., Elizabeth, N. J.....
	Feb. 2, 1887.



BOND, GEORGE MEADE.....	141 Washington street, Hartford, Conn.....	Feb. 2, 1887.
FERGUSON, JOHN WILLIAM .....	(Elected Junior Feb. 2, 1881.) Assistant Engineer New York, Lake Erie and Western R. R., 187 West street, New York City... ..	Feb. 2, 1887.
MACKENZIE, ALEXANDER.....	Major Corps of Engineers U. S. A., Rock Island, Ill.....	Feb. 2, 1887.
THOMSON, GEORGE HUNTINGTON..	Engineer of Bridges New York Central and Hudson River R. R., Room 21, Grand Cen- tral Depot, New York City... ..	Feb. 2, 1887.
WAGNER, SAMUEL TOBIAS.....	Engineer Bridge and Roof Shops, Phoenix Bridge Co., Phoenix- ville, Pa.....	Feb. 2, 1887.
YEATMAN, CHARLES POPE.....	Riplyville, Anderson Co., Ky....	Feb. 2, 1887.

## JUNIORS.

DURYEA, EDWIN, Jr.....	Craigville, Orange Co., N. Y....	Feb. 2, 1887.
PURDY, CORYDON TYLER.....	P. O. Box 732, Pittsburgh, Pa..	Feb. 2, 1887.

## CHANGES AND CORRECTIONS.

## MEMBERS.

CUNNINGHAM, DAVID W .....	Grandin, Cass Co., Dakota.
CURTIS, WENDELL R.....	Rockland, Plymouth Co., Mass.
GRANT, WILLAM H.....	1828 Jefferson Place, Washington, D. C.
PHINNEY, HENRY W. B.....	West Fallbrook, Cal.
POU, ARTHUR.....	Chief Engineer Alabama Midland Railway, Sneads, Fla.
WALLACE, JOHN F.....	Resident Engineer Sibley Bridge, Chicago, Santa Fé and California Ry., Orrich, Mo.
WEEKS, HARVEY R.....	Resident Engineer Chicago, Santa Fé and California Ry., Kahoka, Mo.
WHINERY, SAMUEL.....	Chattanooga, Tenn.

## JUNIOR.

SEAMAN, HENRY B.....	Assistant Engineer in charge Superstructure Kings County Elevated Ry., Garfield Build- ing, Brooklyn, N. Y.
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## DEATH.

WILSON, WILLIAM W.....	Elected Member, January 5, 1870; died Feb- ruary 7th, 1887.
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# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII.—March, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

MARCH 2D, 1887.—The Society met at 20 o'clock. President Worthen in the Chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates were declared elected. As Members: David Frederic Maxwell, St. Stephen, N. B., Canada; Sylvanus Miller, Hatfield, Mass.; George Sullivan Morrill, Boston, Mass.; George Frederick Simpson, New York City; John Thomson, New York City. As Juniors: George Herbert Leland, Providence, R. I.; John Muirhead Stewart, Dobbs Ferry, N. Y.; Arthur Smith Tuttle, Brooklyn, N. Y.; Schuyler Skaats Wheeler, New York City.

A letter from J. E. Watkins, Curator U. S. National Museum, requesting that a committee be appointed on Early Railroad History in regard to matters pertaining to the Department of Steam Transportation in the United States of the U. S. National Museum, was presented, and referred to the Board of Direction, with power to appoint such a committee.

A paper by William Metcalf, M. Am. Soc. C. E., On Steel; some of its Properties; its Use in Structures and in Heavy Guns, was read by the author, and discussed by Lieutenant J. N. Danenhower, U. S. N.; F. V. Greene, Commander H. B. Robeson, U. S. N.; Dr. R. G. Gatling, R. W. Hunt, Major M. Miller, Captain O. E. Michaelis, W. C. Church, and the author.

MARCH 16TH, 1887.—The Society met at 20 o'clock. Past Vice-President Joseph P. Davis in the Chair ; John Bogart, Secretary.

The death, on March 8th, 1887, of James B. Eads, Past Vice-President Am. Soc. C. E., and also the death of Stewart Derbshire, M. Am. Soc. C. E., on January 2d, 1887, were announced.

Mr. G. H. Thomson, M. Am. Soc. C. E., offered to present the Society with photographs of some of the earlier locomotives. The offer was accepted with thanks.

A paper by Calvin Tomkins, Assoc. Am. Soc. C. E., on the Brick Industry of New York was read by the author, and the subject discussed.

Mr. A. M. Wellington, M. Am. Soc. C. E., exhibited some samples of iron from the bridge near Dedham, Mass., where the recent accident on the Boston and Providence Railroad occurred.

Mr. Edward Bates Dorsey, M. Am. Soc. C. E., presented some samples of mortar taken from a house in East Bay Street, Charleston, S. C., after the earthquake.

#### OF THE BOARD OF DIRECTION.

MARCH 30TH, 1887.—Applications were considered. Time and place for next Convention considered, and a committee appointed on the subject. General business transacted. Appropriations were made.

## MEMOIRS OF DECEASED MEMBERS.

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JUSTUS DIRKS, Hon. M. Am. Soc. C. E.

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DIED DECEMBER 26TH, 1886.

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Justus Dirks was born, in 1825, in the small country town of Bergen-op-Loom, in one of the southern provinces of the Netherlands.

Having studied at the Royal Military Academy at Breda, he was in 1845 appointed engineer of the Dutch Waterstaat.

From 1864 till 1883, Mr. Dirks was Chief Engineer of the "Amsterdamsche Kanaal Maatschappij" (Amsterdam Canal Company), and as such charged with the execution of the works for the canal from Amsterdam to the North Sea. During this period his reputation as a most skillful engineer spread beyond his country, and his advice was repeatedly asked, and he was consulted in reference to foreign hydraulic works. In 1879, Mr. Dirks was a member of the Congress held at Paris for the consideration of the projects for the Interoceanic Canal, and in December of the same year he accompanied M. de Lesseps on his first voyage to Panama. Two months afterwards he traveled with that great Frenchman from Panama to New York, and it was on that occasion that Mr. Dirks became acquainted with so many American engineers. A recognition of the impression made by him was shown by his election as an Honorary Member of the American Society of Civil Engineers.

In 1881, the City of Amsterdam chose Mr. Dirks as one of her deputies in the "Second Kamer van de Volks Vertegenwoordiging," or States-General, which position he held till a few months before his death. In 1883 he went to Chili for the purpose of considering a project for a dry dock at Salcahuano, and a year later he traveled to Egypt as a member of the International Committee for the Amelioration of the Suez Canal. Towards the end of 1885 the first symptoms were observed of the fatal illness which was to bring him to his grave. It was the result of his arduous exertion during so many years, which caused a complete exhaustion of his mental and bodily strength.

He died at Scheveningen the 26th of December, 1886, having nearly completed his sixty-second year.

Mr. Dirks was made an Honorary Member of the American Society of Civil Engineers June 2d, 1880.

**JAMES BUCHANAN EADS, M. and F. Am. Soc. C. E.**

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DIED MARCH 8TH, 1887.

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Mr. Eads was born at Lawrenceburgh, Ind., May 23d, 1820.

At this time his father, Thomas C. Eads, was engaged in mercantile business in Lawrenceburgh, but, meeting with reverses, in a few years moved to Louisville, Ky., and soon afterwards to St. Louis. His family consisted of his wife, Mr. Eads, and two daughters.

At this time Mr. Eads was about thirteen years of age. The steamboat on which they took passage was burned, and their household goods, which constituted nearly all of their property, were destroyed.

It was a singular coincidence that this boy, under such distressing circumstances, should have been put ashore upon the very spot where he afterwards located the west abutment of the great bridge that gave him such wide reputation.

Young Eads at once sought employment, that he might contribute to the support of his family. He was fortunate in obtaining a position as clerk in the mercantile house of Williams & Durings; for the senior member of the firm, Mr. Williams, took great interest in the lad, and, noticing his eagerness for knowledge, invited him to come to his house and study the books in his well-selected library. He promptly availed himself of this kind offer, and spent his evenings there, often late at nights, in study.

He was even then earnestly devoted to mechanical and civil engineering investigations. There is no doubt that the indigence of his family through these early years assisted materially in developing that self-reliance which all through his life was one of his marked characteristics, and also gave an additional incentive for the acquisition of useful knowledge.

While occupying the position with Mr. Williams, his father fitted up for him a shop in the basement of their dwelling, where he put his mechanical ideas into form by building a veritable steamboat about six



feet in length, with boilers, engines and all necessary machinery for its own propulsion. He launched it in Chouteau's pond, now Fourteenth street, St. Louis, and had the satisfaction of seeing it navigate the pond by real steam power.

Thus at the age of fifteen he showed that he possessed that inventive genius which afterwards led the nation to seek his services in building an iron-clad fleet for its defense, made him an acknowledged expert in ship-building, and gave confidence in his last years to his widely published views upon an Interoceanic Ship Railway.

At the age of eighteen, in 1838, he obtained the position of purser of a steamboat on the Mississippi River, and took advantage of his opportunities to become intimately acquainted with steamboats in all their details.

His experience on board steamboats led him to devise means for saving the wrecks of boats and barges that were found all along the river.

In 1842 he built a diving-bell boat for recovering cargoes. After successfully performing such work, and testing the appliances to his satisfaction, he fitted out a much larger boat, for not only saving cargoes, but also for lifting the entire hull, cargo and all. He formed a company to carry on "wrecking" operations, and took personal charge of the business, which covered the whole river, from its mouth at the Gulf to Galena, and up the tributaries of the river.

He engaged in this work for about three years, and then, in 1845, sold out his interest and built the first glass-works in the Mississippi Valley; but his hard earned fortune was swept away in the collapse of this undertaking, and he found himself ruined financially, and \$25,000 in debt. He borrowed \$1,500 from his creditors and resumed the business of raising wrecks. In 1849 twenty-nine steamers were burned at the St. Louis levee, most of which he raised and removed. This business was so fortunate and lucrative, that in 1859 he found himself with a fortune of nearly half a million dollars, with his creditors long before this paid in full.

This business required his presence and direction constantly. Its drafts upon his ingenuity were always met by the very best practical appliances demanded in each particular case, and he personally superintended the work, often going down in the diving bell himself when his men were unwilling to go. Small of stature, and to appearance frail and wanting in physical strength, he yet showed a remarkable endurance under physical and mental trials that very few possessed.

This was one of the most valuable experiences of his life, and his opportunities for gaining knowledge of the river itself and for understanding its laws, were seized upon and studied as assiduously as if he had known at the time that he was destined to put his knowledge to world-wide use in designing and constructing works to guide and control the mighty currents which he was contending against in his

wrecking operations—works and their results which have made him, by universal consent, the greatest engineer the world has yet seen in the hydraulics of great rivers. These experiences, and the intimate knowledge gained of the currents, sediments, and other conditions of the “Father of Waters,” enabled him in later years to combat successfully errors founded on ignorance of those facts which had clearly revealed to him the laws which controlled this great river.

Mr. Eads’ first proposition to the United States Government was made in 1856. He proposed to Congress to open and keep open the channels of the Mississippi, Missouri, Ohio and Arkansas Rivers for a term of years by removing wrecks, snags and any other obstructions. The bill giving him this contract passed the House of Representatives but did not pass the Senate, that body failing to take action.

At this time his health failed him and for several years he was more or less of an invalid.

Up to this period he might be said to have been at school. Few men, with or without the advantage of a liberal education, have had so valuable an experience or have made better use of their opportunities.

It was a characteristic of his genius to understand quickly the natural laws whose operations came within his observation and experience, and to evolve new and better appliances than then existed for performing work under these laws. Therefore, with this peculiar and intimate experience with the river and the craft that plied upon it, and with constant study of principles and details, not only as they fell under his eye and practice, but in books, of which he was a great reader and a close student, he was at forty a graduate in the great school of hard, practical experience, and ready to grapple successfully with the grand problems which, by Providence itself, were now thrust upon him for prompt and effective solution. He had no diploma which he could hang on the wall as his evidence of graduation, but his mental training and fitness for work were of more value to him than any collegiate parchment. We should be remiss should we not delay a moment to point to the fact that Mr. Eads was in the true sense of the words a “self-made” man, and that his great success as an engineer was largely due to that incentive to work and study which the hard vicissitudes of life from his early youth kept constantly alive in his heart. A lesson of the greatest practical value is taught by this earlier stage of his life for the encouragement of all those, and their numbers are legion, who have to battle with hard conditions of life in their youth. They may not have that innate genius that characterized him, but they may secure for themselves those qualities which his necessities developed—persistence, courage, and confidence in themselves.

Only three days after the surrender of Fort Sumter, Attorney-General Bates wrote to Mr. Eads as follows: “Be not surprised if you are called here suddenly by telegram. If called, come instantly. In a

certain contingency it will be necessary to have the aid of the most thorough knowledge of our Western rivers and the use of steam on them, and in that event I have advised that you be consulted."

The message alluded to soon followed this letter, and Mr. Eads went immediately to Washington. As a result of conferences with him, at that time, by President Lincoln and members of the cabinet, he was requested to give his views in a written statement, which he did, by proposing to place gun-boats on the rivers, stating the kind of boats and also specifying the location and character of land batteries.

In August, 1861, the proposal of Mr. Eads, made in response to an advertisement of the Quartermaster-General, who had called for bids for a number of iron-clad boats, was accepted. The Department decided to construct seven vessels, each of about six hundred tons; draught, six feet; speed, nine miles per hour; plating, two and a half inches thick, and an armament of thirteen heavy guns. The casemates slanting back at an angle of about thirty-five degrees from the water line, extending entirely around the boat, formed a quadrilateral gun-deck.

The contract was signed August 7th to construct these seven vessels ready for armament in sixty-five days. The conditions, and especially the want of facilities for complying with them, would have discouraged any but the most courageous and self-reliant. Most men would have considered such a task impossible. The foundries, forges, rolling-mills, saw-mills, and machine-shops were idle and closed up; the workmen were enlisting in the service; all the arts of peace were suspended; and the dissensions of the border States had prostrated all business. The materials which were to be put into these gun-boats were yet in their native condition in the forest and in the ore; even the rollers for the plates had to be built.

The following graphic pen-picture of the industries which Mr. Eads at once set in motion is from Boynton's "History of the Navy during the Rebellion," Vol. 1, pp. 502-504.

"The signatures were scarcely dry upon this important contract before persons in different parts of the country were employed upon the work through telegraphic orders issued from Washington. Special agents were dispatched in every direction, and saw-mills were simultaneously occupied in cutting the timber required in the construction of the vessels in Kentucky, Tennessee, Illinois, Indiana, Ohio, Minnesota and Missouri, and railroads, steamboats, and barges were engaged for its immediate transportation. Nearly all of the largest machine shops and foundries in St. Louis, and many small ones, were at once set at work day and night, and the telegraph lines between St. Louis and Pittsburgh and Cincinnati were occupied frequently for hours in transmitting instructions to similar establishments in those cities for the construction of the twenty-one steam-engines and the five-and-thirty steam-boilers that were to propel the fleet. The large rolling-mills of

Gaylord, Son & Co., at Portsmouth, Ohio; those of Swift & Co., at Newport, Ky.; and of Harrison, Chouteau & Valle, at St. Louis, were all employed in rolling the armor-plate. Mr. Thomas G. Gaylord, of Cincinnati, undertook to furnish this important material, and his promptness and energy greatly contributed to the rapid progress of the work. To him justly belongs the credit of rolling the first iron-plating used in the war. Within two weeks not less than four thousand men were engaged in the various details of its construction. Neither the sanctity of the Sabbath nor the darkness of night were permitted to interrupt it. The workmen on the hulls were promised a handsome bonus in money for each one who stood steadfastly at the work until it was completed, and many thousands of dollars were thus gratuitously paid by Mr. Eads when it was finished. On the 12th of October, 1861, the first United States iron-clad, with her boilers and engines on board, was launched in Carondelet, Mo., in forty-five days from the laying of her keel. She was named the *St. Louis*, by Rear-Admiral Foote, in honor of the city. In ten days after the *Carondelet* was launched, and the *Cincinnati*, *Louisville*, *Mound City*, *Cairo* and *Pittsburgh* followed in rapid succession. An eighth vessel, larger, more powerful and superior in every respect, was also undertaken before the hulls of the first seven had fairly assumed shape. Thus one individual put in construction and pushed to completion within one hundred days a powerful squadron of eight steamers, aggregating five thousand tons, capable of steaming at nine knots per hour, each heavily armored, fully equipped, and all ready for their armament of one hundred and seven large guns. The fact that such a work was done is nobler praise than any that can be bestowed by words."

"It is to be regretted, however, that the promptness and energy of the man who thus created an iron-clad navy on the Mississippi was not met on the part of the Government with an equal degree of faithfulness in performing its part of the contract. On one pretext or another, the stipulated payments for the work were delayed by the War Department, until the default assumed such magnitude that nothing but the assistance rendered by patriotic and confiding friends enabled the contractor, after exhausting his own ample means, to complete the fleet. Besides the honorable reputation which flows from success in such work, he has the satisfaction of reflecting that it was with vessels, at the time his own property, that the brilliant capture of Fort Henry was accomplished, and the conquest of Donelson and Island No. 10 achieved."

"The ever-memorable midnight passage of Island No. 10 by the *Pittsburgh* and *Carondelet*, which compelled the surrender of that powerful stronghold, was performed by vessels furnished four or five months previous by the same contractor, and at the time unpaid for."

In April, 1862, designs were solicited by the Navy Department from Mr. Eads for light-draught armored vessels for use on Western

rivers, with rotating turrets. He submitted plans on his own designs especially for the turrets and machinery for handling the guns. The models for these turrets are now, through the courtesy of the heirs of Mr. Eads, the property of the Society, and we therefore, give a brief description of them.

The guns were placed on a platform moving vertically on a steam piston. They were loaded in the hold of the vessel, and quickly raised by the piston to the level of the embrasures, which were but little larger than the muzzles of the guns; by a simple contrivance the muzzles were kept in constant range with the embrasures, so that, by depressing the platform elevation was given to the guns, and raising it depressed the guns; twenty-one degrees of elevation and five degrees of depression were thus obtained. Horizontal steam cylinders attached to the guns ran them into position, and their recoil was absorbed by the pistons; the ports were opened by steam and closed instantly by the recoil of the gun, and the walls of the turret rotated on spherical balls. Many of the movements were automatic, and one man, by handling the levers and valves, could easily operate all the movements of the gun with absolute precision.

He constructed in all fourteen heavily-armored gun-boats and converted seven transports into what were called "tin-clads" or musket-proof gun-boats; and he built, in addition, four heavy mortar-boats.

"Thus was commenced the squadron on the Western waters which became afterward such an important and even indispensable arm of defensive and offensive operations. Without it the rebellion could not have been overcome, for the Mississippi could not have been opened, and the lines of the rebels could not have been broken through. Others shared nobly in the subsequent work, but Mr. Eads was the efficient and successful pioneer, and by him, almost unaided, the Government was enabled to put the first fleet of iron-clads on the Mississippi and its tributaries. Such men deserve a place in history by the side of those who fought our battles." (See Vol. I, pp. 506-507, Boynton's "History of the Navy during the Rebellion.")

His next work was the construction of the arched bridge over the Mississippi River at St. Louis, with whose history and plans most of the older Members of the Society are familiar, hence only its principal features will be described. Since its construction, in the years 1867-74, many important bridges have been built and deep foundations sunken, but at the time the work was commenced on this bridge there were no well-known precedents for some of its principal features or dimensions. The sudden changes in the river bed at this point made it necessary to go to the bed rock for the foundation of the piers. The base of one pier is 136 feet below high water, and it was sunken through 90 feet of sand and gravel; another is 130 feet below high water, and it went through 80 feet of sand.

The piers are massive structures, one of them weighing 45,000



tons. The central span is 520 feet in the clear, and the two side spans 502 feet. The plan of the superstructure is a ribbed arch carrying a double-track railway with a broad wagon way above.

By the requirements of the Act of Congress the clear height was fixed at 50 feet above the City Directrix.

To show how doubtful was considered the practicability of erecting spans of the length required, the following extract is given from the resolutions adopted by a convention composed of twenty-eight of the leading civil engineers of the United States, and whose names were appended to the report of the convention: "*Resolved*, That we as practical engineers cannot conscientiously recommend to the parties in interest to venture upon the construction of spans of as great length as the maximum one prescribed by law " (500 feet).

Mr. Eads however so clearly proved the correctness of his plans and showed that engineers of international reputation had designed even longer spans, which had been approved by their brother engineers, and that there were in existence at the time bridges whose spans were nearly equal to his proposed plans, that the Bridge Company were fully satisfied with his designs, and he proceeded with the construction of the work.

The years spent in this great enterprise were fraught with care, anxieties and constant labors.

No one can read his masterly reports upon this bridge without being deeply impressed not only with his intimate knowledge of the details of the work, but with the fact that he designed nearly all of them himself. The conditions were so extraordinary in many respects, that it required a master mind, a real mechanical genius, to devise and invent many appliances, particularly for the deep foundation work. The "Eads' sand pump," a model of which is in the possession of the Society, although very simple, was a novel device and utilized forces in such a way as to greatly facilitate the removal of the material from under the caissons. Many of the peculiar arrangements of the air-locks were devised by Mr. Eads for that bridge, and some of them were afterwards used in sinking the piers of the Brooklyn Bridge.

In 1881 the historian of the St. Louis Bridge, Professor C. M. Woodward, Assoc. Am. Soc. C. E., of Washington University, paid the following well-deserved tribute to the engineering of the east abutment of the bridge: "The construction of the east abutment was a signal triumph in engineering. It was quite unparalleled both in size and in the depth to which it was sunk, and it stands to-day the deepest subaqueous foundation ever built."

As to the superstructure, it marked an era in bridge-building, and particularly in the character of materials. The obstacles met with in the manufacture of steel to meet the requirements of spans of this kind and length were serious and many. The steel-makers found that

their facilities were inadequate to the magnitude of the work they had undertaken; they had no workmen of sufficient skill, and their foremen had never worked steel in such large masses. The rigid tests, both for maximum strength and for elastic limit, were new, and the character of the workmanship was quite exceptional.

Speaking himself of the bridge, and of the various unforeseen expenses and difficulties that had attended its construction, Mr. Eads, in his report to the Bridge Company in 1871, closes as follows:

"When all of the many difficulties that have retarded this great work shall have at last been surmounted and the bridge becomes an accomplished fact, it will be found unequalled in the important qualities of strength, durability, capacity and magnitude by any similar structure in the world. Its great usefulness, undoubted safety, and beautiful proportions, will constitute it a national bridge, entitling those through whose individual wealth it has been created to the respect of their fellow men; while its imperishable construction will convey to future ages a noble record of the enterprise and intelligence which mark the present times."

The magnitude of the work may be appreciated from the following summary of its dimensions, quantities and weights:

Length of the piers at base about 85 feet, width about 60 feet; length at top about 63 feet, width about 24 feet.

Height from bed rock to top of masonry: greatest, 192 feet 9 inches; least, 112 feet 8½ inches.

Foundations below low water: greatest depth, 94 feet; least depth, 13 feet. Below high water, greatest 135 feet 7 inches, least, 54 feet 7 inches.

Total amount of masonry and concrete, 102 897 $\frac{6}{10}$  cubic yards.

Total weight of steel, iron, wood and tracks, 13 135 500 pounds.

The following from London *Engineering*, written just before the completion of the bridge, will show the appreciation by the engineering profession in England of the magnitude of the work and of the great qualities demanded for its success.

"Our present requirement being to select some example of the most highly developed type of bridge-building of the present day, we have no difficulty in passing before ourselves in mental review the different works now in progress throughout the world, and we have still less difficulty in selecting as our example the magnificent arched bridge now almost completed by Captain Eads at St. Louis. In that work the alliance between the theorist and the practical man is complete. The highest powers of modern analysis have been called into requisition for the determination of the strains; the resources of the manufacturer have been taxed to the utmost in production of material and perfection of workmanship; and the ingenuity of the builder has been alike taxed to put the unprecedented mass into place. In short, brain-power has

been called into action in every department. One long-sighed-for result, the welding of the theoretical and practical man into one homogeneous mass, without which no truly great undertaking could possibly be carried out, has at last been attained."

The St. Louis Bridge was scarcely completed when Mr. Eads turned his attention practically to a subject that had long been in his mind and desires, since his proposition to the Government in 1856 to open up and maintain the channels of the rivers, and that was the opening of the mouth of the Mississippi River, where the sand bars lying at the embouchure of the passes into the Gulf, had become a very serious obstruction to the commerce between the Mississippi Valley and the ocean.

In February, 1874, he made a formal proposition to Congress to open the mouth of Southwest Pass and maintain the channel. This he agreed to do at the sole risk of himself and associates. The attacks upon his proposition from all sides, and the gallant and victorious fight which he waged single-handed in Congress and out of it, have already become a part of the history of this important work, and need not be repeated here. The valor, fortitude and persistence of Mr. Eads in these controversies only showed his natural traits of character, and revealed an adversary in polemic discussion that few cared to meet. His papers, addresses and communications to Congress and to the magazines and newspapers, during the preliminary stages and the construction of this work, are probably unsurpassed in value as engineering expositions of the principles controlling the flow of water, the movement and deposition of sediment, and of the correct methods of river improvements. The principal opposition to his proposal came from those army engineers who had proposed to solve the problem by building a canal from Fort St. Philip, on the main river above the head of the Passes, to the adjacent sound. After considerable discussion a commission of engineers, composed of three army engineers, three civil engineers and a member of the United States Coast Survey, was authorized by Congress.

At the next session of Congress this commission, after personally examining certain important rivers of Europe, which had been improved by jetties, reported in favor of the plan proposed by Mr. Eads, and recommended its application to the South Pass, the smallest of the three, where the depth on the bar was about eight feet, in place of the Southwest Pass, selected by Mr. Eads, where the depth was over twelve feet.

The work was commenced in the summer of 1875, the construction of which required about four years, the channel demanded by the contract with the Government having been obtained in July, 1879. Its dimensions were, a depth of 26 feet with a width of 200 feet at that depth, and a central depth of 30 feet without regard to width.

Mr. Eads brought to the construction of this important work the

same genius that had characterized his management of the St. Louis Bridge. No obstacle, whether of an engineering or financial character, dismayed or even discouraged him. His great qualities were exhibited on this work in a marked degree. His knowledge of the laws of currents; his predictions of complete success by working in accordance with these laws; his unalterable determination to achieve success, and his unfaltering faith in the darkest hours of that work were indelibly impressed upon the minds of his intimate associates, so that, whatever his detractors said, those who knew him best felt the inspiration of his great genius, a confidence in his consummate skill, and a repose in his unswerving confidence in the final result.

The following words from an address delivered at St. Louis immediately after the passage of the Jetty Act show the high purpose and the implicit faith of Mr. Eads. He rested calmly in the operation of laws which he knew, from practical experience and careful study, were controlling the forces with which he was dealing.

"If the profession of an engineer were not based upon exact science, I might tremble for the result in view of the immensity of the interests which are dependent upon my success. But every atom that moves onward in the river, from the moment it leaves its home amid crystal springs or mountain snows, throughout the 1 500 leagues of its devious pathway, until it is finally lost in the vast waters of the Gulf, is controlled by laws as fixed and certain as those which direct the majestic march of the heavenly spheres. Every phenomenon and apparent eccentricity of the river, its scouring and depositing action, its caving banks, the formation of the bars at its mouth, the effect of the waves and tides of the sea upon its currents and deposits, are controlled by laws as immutable as the Creator, and the engineer needs only to be assured that he does not ignore the existence of any of these laws, to feel positively certain of the result he aims at.

"I therefore undertake the work with a faith based upon the ever-constant ordinances of God himself; and so certain as He will spare my life and faculties for two years more, I will give to the Mississippi River, through His grace, and by the application of His laws, a deep, open, safe and permanent outlet to the sea."

The jetties which Mr. Eads designed and built extend from the land's end at the mouth of the South Pass about two and a quarter miles out over the bar and into deep water in the Gulf. The jetties are parallel, and the channel between them is about seven hundred feet wide. They are built of willow mattresses, sunken by stone and capped near the sea ends with massive concrete blocks, the largest of which weigh 181 tons, and were, at the time they were put in position, the largest blocks ever placed on sea walls.

The works at the Head of the Passes required skillful designing, for the conditions there were very complicated. By employing permeable

constructions, deposits were induced and the river compelled to excavate, by its accelerated current, a channel through the bar which had obstructed the entrance to South Pass, and on which there were but 15 feet of water.

“As at the Jetties, so at the head of the Passes, the works have simply assisted nature in opening channels and in building banks.

“When we contemplate the fact that these works are composed almost wholly of light willows with a large portion of the mattresses standing on edge, simply as screens to check the current and cause deposit, they constitute a remarkable illustration of how completely the immense forces of nature may sometimes be controlled by a wise use of the most inexpensive and unsubstantial materials, which nature seemingly places within convenient reach of man for the very purpose.

“Here, by the gentlest influences the mighty current is swayed and directed completely obedient to his will. There is no instance indeed in the world where such a vast volume of water is placed under such absolute and permanent control of the engineer, through methods so economic and simple as those adopted at the head of the Passes of the Mississippi River.”

The character of this work: its great importance to the commercial interests of the country and the world; its successful accomplishment; the continued maintenance of the deep and wide channel which the works created; the difficult engineering problems which were solved so successfully, all conspired to place Mr. Eads in the foremost rank of hydraulic engineers, as his great bridge had already placed him in the front rank of bridge engineers.

The unselfish patriotism and desire to promote the welfare of his country are seen in nothing in his life more than in his persistent efforts to secure the improvement of the Mississippi River from the Gulf to the mouth of the Ohio. Some of the most laborious years of his life were spent in efforts to obtain the legislation from Congress necessary to inaugurate a comprehensive system of river improvement under a mixed commission. It is not enough to say that he did more than any one to accomplish this; it is only the truth to say that without his untiring efforts neither the commission nor the improvement works would have existed.

In the clearest and most convincing manner he stated the plan of improvement in documents addressed to Congress and in addresses before public meetings in the Mississippi Valley. Between 1874 and 1879 he outlined one of the most magnificent and comprehensive plans which hydraulic engineers ever undertook in this or any other country. By untiring efforts he at last brought about a public sentiment in favor of the improvement and obtained the necessary Congressional action.

The commission was appointed in 1879 and presented its preliminary report February 17th, 1880. He was appointed on this commission and



served two years, when his failing health and the cares of other important business compelled him to resign and go abroad. He, however, to the time of his death, was most deeply interested in this great work, and deplored what he believed to be the departure of the commission from the true principles of the improvement, and combated false methods with all the strength of his great intellect. This is no place to indulge in controversial discussions, but it is only a duty to Mr. Eads to make a brief statement of the views and plans, for whose adoption, execution and preservation he had been for several years such an earnest and untiring advocate.

The improvement of the great river and the welfare of the great valley were among the most cherished objects of his life, and he could not brook any departure from the correct principles, even though it was counseled by his best friends. As far as this important question was concerned, they were his enemies who opposed its correct treatment, and he mercilessly fought them in order that he might bring about the adoption of correct plans in place of what he believed to be incorrect ones. This intense earnestness in the discussion of this, to him, vital question, often made him appear a bitter and unrelenting foe to his opponents; but no man ever lived with a kinder heart than he, even towards those who opposed him. To him the unfolding of great and correct principles was more than personal friendships. His beliefs were his friends, if they held within their grasp and scope the weal of humanity.

The following extracts are from his "Minority Report of Mississippi River Commission, April, 1882."

"I have named three controlling principles which are present in every problem presented by the characteristic phenomena of the river. Each one of these is very simple in itself. It is however absolutely necessary to remember each of them to fully comprehend the subject, and to be able to recognize the respective influence of each in creating these phenomena. I will briefly repeat them to more strongly impress their importance. The *first* is the force producing the current. This force is simply the result of the fall of the river from a higher to a lower level. The *second* is the frictional resistance of its bed. The *third* is the intimate relation between the quantity of sediment carried in the water and the velocity of the current. If we increase or decrease the current from any cause, we increase or decrease the quantity of sediment carried by the river. We can increase or decrease the current temporarily by either of two methods, namely, by altering the slope, or by altering the frictional resistance. Therefore by these two methods the scouring and depositing effect can be produced. If we increase the current during the floods we produce a greater deepening and enlarging of the channel through the shoals, and they are left in better condition during low water, and at the same time we ultimately lower the height of the flood. If we decrease the current we produce shoals and higher floods."

He constantly and persistently held that the "jetty" principle, which the Commission originally adopted, should not be departed from; that the contraction of the channel, by permeable works, to its normal width of about 3 000 feet would accomplish the desired result, which would be not only a deepening of the channel for navigation, but a restoration of the bed of the river to an approximately uniform plane, in place of the strikingly irregular bed, with its deep holes and uplifting bars, which were due entirely to the varying widths of the river in its unrectified condition; and that therefore it was utterly useless to waste money in impracticable attempts to hold the caving concave banks of the river by costly revetments, which, he contended, had already swallowed up millions of public money without any useful result to show for it.

From the first he contended that the proper improvement of the river by deepening the channel would decrease the frictional resistance to the current by lessening the surface exposed to it; that then the flood volume would flow on lower slopes; that the practical result would be the lowering of these floods; that the necessity for high levees would no longer exist, and that the 30 000 square miles of rich alluvial lands, now subject to inundation, would be effectually reclaimed by the same works that produced and maintained a deep channel from Cairo to New Orleans.

In all the years during which he worked and fought for this grand result he had no selfish interest to subserve; no contract to execute; nothing himself to gain; and he had no thought even of the fame that would come to him as the crown of his unremitting efforts, for wealth he had already, and fame was not wanting.

The channel at the mouth of the Mississippi River was obtained in July, 1879. The Panama Canal Congress was held in May of the same year.

The attention of the civilized world was directed, as never before, to an interoceanic transit-way. Mr. Eads conceived the idea of extending the Mississippi River, commercially speaking, into the Pacific Ocean; and of opening up to the eastern coast of Mexico and the States bordering the Gulf and to the great valley of the Mississippi, the rich markets of the Pacific, and at the same time to connect the Atlantic and Pacific coasts of the United States by the shortest possible route by way of the Tehuantepec Isthmus, where a crossing for ships would effect a saving of 2 000 miles over the Panama route, and 1 500 miles over the Nicaragua route. As a canal was impracticable at Tehuantepec, he proposed to build a ship railway for the transportation of ocean vessels over the 140 miles of land that separate the Gulf of Mexico from the Pacific Ocean. He at once began the preliminary plans for the work, and made a careful study of the subject in the fall and winter of 1879.

On March 9th and 13th, 1880, he appeared before the select Commit-

tee of the House of Representatives on Inter-oceanic Canals, and replied to Count de Lesseps, who was advocating the construction of the Panama Canal. In his remarks Mr. Eads explained, in considerable detail, his plans for a ship railway, and contended that it was entirely practicable. On August 11th, 1880, he delivered an address before the San Francisco Chamber of Commerce on the "Inter-oceanic Ship Railway," in which he said:

"Standing in your presence to-day, and conscious of the full import of my words, I declare to you, *First*, that a ship railway can be constructed at one-half the cost of a canal with locks, and in one-half the time. *Second*, that when completed, the railway can be maintained and operated at a cost not exceeding that of a canal. *Third*, that your largest vessels with their cargoes can be safely carried from ocean to ocean in one-half the time required for a passage through the canal." And he then gave additional reasons for his preference for a railway.

In November, 1880, he went to Mexico, and obtained a valuable concession from the Mexican Government for building a ship railway. He instituted the preliminary surveys by the assistance of that government, and went with the engineering party to the Isthmus on board a Mexican government vessel which had been placed at his disposal.

In March, 1881, he presented his views on this subject in the *North American Review*, and explained and enforced the controlling principles at considerable length.

In the winter of 1881 he made a proposition to Congress to build the railway at his own expense and at his own risk, provided the Government would guarantee a dividend of 6 per cent. for 15 years after he had, by the actual construction and operation of the railway, proven its practicability. His views of the feasibility of the railway were supported by the professional opinions of a large number of practical experts both in the United States and England, and the Senate and House Committees favorably reported the bill, but the Senate failed to take action upon it.

In 1885 Mr. Eads obtained a modification of the concession from Mexico, by which that Government guaranteed that one-third of the net revenue should amount to \$1 250 000 per annum, and granted several other important changes which increased the value of the concession.

He then introduced a new bill in Congress by which, when the Ship Railway should be entirely completed and put into operation, transporting large ocean vessels fully laden, the Government guaranteed that two-thirds of the net revenue should amount to \$2 500 000, Mexico having guaranteed the other third.

This bill was favorably reported by the committee of the two Houses before the end of that session, but in the last session of Congress it was deemed advisable to exclude all guarantee clauses and ask for a simple charter. Mr. Eads went to Washington this last winter, in January,

although in very poor health, to secure the passage of the Act, confidently believing that it would insure the raising of the capital, in this country and England, necessary to build the railway. He was not able to remain in Washington, and by the advice of his physician and friends sailed for Nassau, N. P., Bahamas, where he died after a short illness. After his arrival at Nassau his health rapidly improved, but he contracted a slight cold which resulted in congestion of the lungs. This was the remote cause of his death, but the direct cause was uræmia, from which he had been a great sufferer for several years.

During these years, and until his death, Mr. Eads not only advocated the important project of a ship railway, but devoted much of his time and attention to the preliminary work necessary to place the enterprise squarely and fully before the world. He did not hesitate to support his opinions with his money; and although he had associated with himself about ninety promoters, all financially interested in the work, he went far beyond any of them in furnishing the necessary funds for making elaborate surveys, plans and a model illustrating them, and in meeting the expenses incident to so great a work. His views, advanced by himself and those associated with him, and sent to all parts of the civilized world, have gained a firm foothold in the belief of thinking men everywhere.

His last engineering work, while sick at Nassau, was the examination and review of the plans for an improved hydraulic lift for the Ship Railway which he had placed in the hands of a mechanical engineer before he left this country.

He exhibited in his last hours the same heroic courage and sublime faith that characterized his entire life. He was not afraid to die, but such was his devotion to the great enterprise in which he was engaged, so strong was his presentiment that he would live to see the fruition of his hopes, that he could not think of leaving the world until his work was done, and he should see with his own eyes what the great poet saw in vision.

“Lo, ships, from seas by nature barred,  
Mount along ways by man prepared,  
Along far-stretching vales, whose streams  
Seek other seas, their canvas gleams;  
And busy towns grow up on coasts  
Thronged yesterday by airy ghosts.”

The pure motives which actuated Mr. Eads in this great project, and the lofty purpose that led him to devote his life and bend all his energies to its accomplishment, can be clearly read between the lines of the following extract from his address before the Boston Society of Arts, May 19th, 1885:

“When this work is completed, as I am sure it will be, and that long before a canal is cut across the American Isthmus, the benefits will be

felt by our fellow men all over the world. Not only in lessening the cost of transportation on the necessities and luxuries of life, and in shortening the long, weary, trackless distances which now separate nations from each other, and by opening new markets for the multitude of commodities which are interchanged by the various peoples of the earth, but also by bringing distant communities into more social and commercial relations with each other, whereby the better sympathies and sentiments of each will be promoted, their prejudices removed, the amenities of life increased, and the benefits of civilization, science and religion more surely tend to the increase of 'peace on earth, good-will to men.' This work, when finished, will be the realization of the ardent wish of statesmen and philanthropists everywhere; the dream of kings and conquerors during the last three hundred and fifty years, and a fitting supplement to the grand achievements which have marked the progress of the nineteenth century."

The principal engineering works of Mr. Eads have now been very briefly sketched. To speak of them at any length would require too much space, although much more that is instructive and delineatory of Mr. Eads' character could profitably be stated.

In addition to these more important undertakings, he examined and reported upon many engineering projects.

In March, 1878, at the request of the City Council of Jacksonville, Fla., he made a report upon the practicability of deepening the channel through the bar at the mouth of the St. John's River.

After the construction of the South Pass Jetties he was requested by the people of Galveston, Texas, to formulate a plan and take a contract from the United States Government to improve that harbor. He gave long and careful attention to the project, but Congress was not willing to grant a contract for the work.

At the request of the Canadian Government he examined the harbor of Toronto, Canada, and made plans for its improvement.

At the solicitation of the Mexican Government he made surveys and elaborate plans for the improvement of the harbors of Vera Cruz and Tampico.

He examined into the problem of the drainage of the Sacramento River, as Consulting Engineer of the State of California.

In 1884, by request of the Mersey Docks and Harbor Board of Liverpool, he appeared before a Committee of the House of Lords and gave his testimony as to the effect of the terminal works of the Manchester Ship Canal upon the estuary of the Mersey and the bar at Liverpool. He brought to the solution of this question that same keen insight into hydraulics and the same close application that had made him so successful in this country. He showed so plainly the deleterious effects of the proposed plans that the Committee decided against them. They have since been changed to conform to his suggestions.



The Emperor of Brazil, Dom Pedro II, held Mr. Eads in high esteem, and made a special visit to the South Pass Jetties when he was in this country. He afterwards offered Mr. Eads the position which was given, on his recommendation, to the lamented W. Milnor Roberts, Past President Am. Soc. C. E. About two years ago he was requested by the Brazilian Government to examine the mouth of the Rio Grande do Sul and make plans for its improvement, but ill health and pressing business prevented his acceptance of the offer.

Mr. Eads traveled extensively in this and foreign countries, and often in pursuit of information bearing upon the engineering enterprises which he had in hand.

In 1877 Mr. Eads received a diploma from the University of the State of Missouri conferring upon him the Honorary degree of LL.D.

The letter of the President of the University, Hon. James S. Rollins, which accompanies the diploma, is worthy of being placed in this memoir, for it shows the appreciation in which Mr. Eads was held by those who knew him well in the State where the larger part of his life was spent. "Allow me to say that this high honor has not been bestowed upon you as a matter of mere compliment to an eminent citizen of the State in which he resides, but on account of the high appreciation of your high position as a man of great scientific attainments, and of the practical uses of this extensive knowledge in improving the facilities of commerce, developing the internal resources of the country, and adding incalculably to its wealth and to the happiness and prosperity of the people.

"The bestowal of such honors and the recognition of your great services in accomplishing the noble ends at which you aim will be some remuneration to you for the sacrifices and labors which you have undergone in achieving such great advantages for our common country."

In 1884 the Albert Medal was awarded to Mr. Eads, he being the only American on whom this distinguished honor has been conferred.

The letter of the Secretary notifying Mr. Eads of the award is given following, as well as the resolutions of the Society.

"SOCIETY FOR THE ENCOURAGEMENT OF ART,

"MANUFACTURES AND COMMERCE,

"JOHN STREET, ADELPHI, LONDON, W.C.,

"June 10th, 1884.

"SIR,—I am directed by the Council of this Society to inform you that they have had the pleasure of awarding to you the Society's Albert Medal as a token of their appreciation of the services you have rendered to the science of engineering.

"The Medal was founded in 1862 in memory of His Royal Highness

the Prince Consort, and is awarded annually for distinguished merit in promoting arts, manufactures or commerce.

"I may add that the award is made with the approval of His Royal Highness the Prince of Wales, the President of the Society, to whom it has been submitted. Should you be in England I have no doubt His Royal Highness will be pleased to present the Medal to you himself, as he has done in previous cases; but should there be no opportunity for his doing so, he will arrange for its transmission to you.

"I inclose for your information a list of the distinguished men of science to whom the Medal has been given in previous years.

"I have the honor to be, Sir, your obedient servant,

"H. T. WOOD,

"*Secretary.*"

"JAMES BUCHANAN EADS.

"The following are the precise terms of the award:

"*Resolved*, That the Albert Medal be awarded to Captain James Buchanan Eads, the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world."

Mr. Eads took just pride in this medal, for it had been conferred previously upon such distinguished men as Sir Rowland Hill, Napoleon III, Sir Joseph Whitworth, Ferdinand de Lesseps, Sir Henry Bessemer, Sir C. W. Siemens, Sir William Armstrong, Sir William Thompson, and several other illustrious persons.

Mr. Eads was elected a Member of the American Society of Civil Engineers December 16th, 1868, and a Fellow March 30th, 1870. He was Vice-President from January 18th, 1882, to January 17th, 1883.

He was elected a Member of the Institution of Civil Engineers, Great Britain, May 4th, 1869, and Fellow of the American Association for the Advancement of Science in 1879, and a Member of the British Association in 1884. He was a Member of the Society for the Encouragement of Arts, Manufactures and Commerce. He was also a Member of the Engineers' Club of St. Louis and of the American Geographical Society. He was for two years President of the Academy of Science of St. Louis.

The inventive genius of Mr. Eads is shown in the fact that nearly fifty patents were issued to him by the Governments of the United States and England for useful inventions in naval warfare, bridge foundations and superstructure, dredging machines, navigation, river and harbor work, and ship-railway construction.

Mr. Eads was married, when about twenty-five years of age, to Martha Dillon, of St. Louis, by whom he had two daughters. He married Mrs. Eunice S. Eads, a widow, in 1854, who had three daughters at the time of his marriage. Mrs. Eads and the five daughters survive Mr. Eads.

This memoir would be incomplete if it did not give some of the leading characteristics of this truly great man, whose friendship we prized so highly and whose great qualities and useful life may well be emulated by us all.

Mr. Eads thoroughly mastered all the details of every subject which he took up for investigation or execution. His method of writing partook of the same characteristic. He was not a rapid writer, but a slow and careful one, often going over and over the same paragraph and sentence. He was never satisfied, and would often recall the proof to correct some expression or word that did not exactly suit him or did not convey his precise meaning.

In taking up any project he gave it long, careful and thorough examination, looking at it from all sides, and laboriously reading about it and studying upon it before committing his own mind to it or expressing his belief in its practicability or utility. When once, however, his mind was made up, it never changed; once having stepped forward he never took a backward step, no matter what obstacles confronted him; his faith never wavered, when once set upon the fulfillment of any object, and the final result shone always clear and bright above all the din and smoke of the hard conflicts through which he always seemed to be destined to march to victory. He never attacked, but, as he often said, was constantly resisting attacks and maintaining his views against the adverse opinions of opponents. He was always vigilant, not for his own interests or his reputation, but for the principles which he espoused and the enterprises which he projected and promoted.

His genius led him often unwillingly far in advance of his contemporaries, and, like all great inventors and men of genius, he was forever battling for principles and projects that seemed visionary and impracticable; but, unlike most inventors and discoverers, he possessed all those strong business qualities, and that sound common sense, practicality and tact that rounded out his character and made him a giant among men.

Possessing such qualities he could never be anything but sanguine. He never became discouraged for a moment, however dark it seemed to those around him; and although often broken down physically, his mind and soul were always in the serene atmosphere of hope and faith.

His genius was versatile as his works show us, and he had the happy faculty of adapting himself most delightfully to those with whom for the moment he found himself; and all, young and old, cultured and uncultured, enjoyed his society. He was always to every one extremely cordial and pleasant, never seemingly in haste; and, with enormous burdens of business pressing upon him, he was never so engrossed or careless of others as to be heedless of their presence or of their just claims upon his time or attention.

He was not self-conscious, and, though one of the grand figures of our

age, he never stooped to any one, but took them cordially by the hand, entered at once into their troubles, cares or business, and made them feel that he was their brother.

He was generous to a fault, and no one ever went away from him empty handed. His kind acts and charitable deeds, if all were recorded, would fill a volume, and many were the beneficiaries that none knew of but he and they.

This generous trait led him to give due credit to all his assistants, however humble their position or unimportant their work, and to those of us who were intimately associated with him, he took great pains to give praise, and frequently went out of his way to do it. He often said that just praise and full credit given by him to his assistants would not detract from his own.

We mourn his departure and miss his familiar face and form, his kind, encouraging words, and, above all, that incentive to nobler deeds that comes from intimate association with a great and good character; and in his death we lose an associate and a friend, and the world a benefactor.

**JAMES STEWART DERBISHIRE, M. Am. Soc. C. E.**

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DIED JANUARY 2D, 1887.

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James Stewart Derbshire was born at Quebec, Canada, on the 23d of October, 1851, so that at the time of his death he had just entered his thirty-sixth year. His father was for many years Queen's Printer, one of the most lucrative positions in the gift of the Canadian government.

After some years spent at school in Lennox, Quebec, he was placed under the care of a private tutor in England, whence he was removed to Oxford, entering Magdalen Hall, and it was there no doubt that he imbibed that love for the classics which lasted through life. On leaving Oxford, it was intended that he should read for the Bar, but, following the bent of his inclinations, he chose the study of civil engineering, and there is little doubt that, had his life been spared, his great mental endowments, combined with his love for the profession, would have raised him high among the foremost engineers of the present day. At the outset of his professional career his services were employed by the Dominion Government in the Department of Public Works, but this employment he relinquished to assist in the construction of some local railways in his native province, returning however to the government service after an absence of some two years. For some time Mr. Derbshire's health had been failing, and a journey which he took to the Northwest last spring, in the hope of restoring it, only served to hasten the end, and he returned home in the summer feeling that his days were numbered.

Mr. Derbshire was of an affectionate, warm, but retiring disposition. Like every man who is worth his salt he was strong and settled in his opinions; warm and true in his friendships; and, what every engineer ought to be, enthusiastically fond of his profession.

Mr. Derbshire became a Member of the American Society of Civil Engineers April 2d, 1884



## LIST OF MEMBERS.

## ADDITIONS.

## MEMBERS.

Date of Election

MAXWELL, DAVID FREDERIC.....	Chief Engineer New Brunswick Government Railways, St. Ste- phen, N. B., Canada.....	Mar. 2, 1887.
THOMSON, JOHN.....	Engineer Consolidated Tele- graph and Electrical Subway Co., 143 Nassau street, New York City.....	Mar. 2, 1887.

## JUNIORS.

LELAND, GEORGE HERBERT.....	65 Westminster street, Provi- dence, R. I.....	Mar. 2, 1887.
STEWART, JOHN MUIRHEAD.....	Assistant Engineer Aqueduct Commission, P. O. Box 87, Dobbs Ferry, N. Y.....	Mar. 2, 1887.
TUTTLE, ARTHUR SMITH.....	43 Chauncey street, Brooklyn, N. Y.....	Mar. 2, 1887.
WHEELER, SCHUYLER SKAATS....	Superintendent "C. and C." Electric Motor Co., 90 South Fifth avenue, New York City.	Mar. 2, 1887.

## CHANGES AND CORRECTIONS.

## MEMBERS.

COMSTOCK, CYRUS B.....	Lt.-Col. Corps of Engineers, Bvt. Brig.-Gen. U. S. A., 33 West Houston street, New York City.
GRISWOLD, FRANK L.....	1192 Calle Santa Fé, Buenos Aires, Argentine Republic.

- RAY, NATHANIEL C. .... Resident Engineer Montana Central R. R.,  
Butte, Montana.
- RUGGLES, WILLIAM B. .... Delhi, Ohio.
- MERRILL, WILLIAM M. .... General Manager Hannibal and St. Joseph R.  
R., Kansas City, St. Joseph, and Council  
Bluffs R. R., St. Joseph, Mo.
- WURTELE, ARTHUR S. C. .... 53 West Genesee street, Buffalo, N. Y.

## JUNIORS.

- LUCAS, D. JONES ..... St. Louis and Chicago Ry., Springfield, Ill.
- SHEPARD, WILLIAM T. .... 31 and 32 Insurance Building, New Haven,  
Conn.

## DEATH.

- EADS, JAMES B. .... (Past Vice-President.) Elected Member, De-  
cember 16, 1868; elected Fellow, March 30,  
1870; died March 8, 1887.

# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII.—April, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

APRIL 6TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates declared elected. As Members: Horace Andrews, Albany, N. Y.; Frank Graef Darlington (elected Junior February 6th, 1884), Zanesville, Ohio; Joseph Thompson Dodge, Helena, Montana; Edward Adolph Hermann, Indianapolis, Ind.; Henry Clay Jennings, Milwaukee, Wis.; Samuel Fisher Morris, Yonkers, N. Y.; Benjamin Franklin Thomas, Louisa, Ky. As Juniors: George McGrew Farley, Toledo, Ohio; Gideon Frederick Haynes, Waltham, Mass.

The election as Fellow of the Society of Harry Gilbert Darwin, of Glen Ridge, N. J., was announced.

A circular letter from the Committee on the 24-o'clock system of the General Time Convention was read.

The paper previously read On Steel; some of its Properties; its Use in Structures and in Heavy Guns, by William Metcalf, M. Am. Soc. C. E., was discussed by Theodore Cooper, E. B. Dorsey, Thomas Egleston, Joseph M. Knap, F. Collingwood, Members Am. Soc. C. E.; Lieutenant W. H. Jaques, U. S. N., Dr. R. J. Gatling, Mr. A. H. Emery, Professor De Volson Wood and Mr. John Coffin.

APRIL 20TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the chair; John Bogart, Secretary.

An abstract of discussions on the paper by William Metcalf, M. Am.

Soc. C. E., On Steel; some of its Properties; its Use in Structures and in Heavy Guns, presented by Commander C. F. Goodrich, U. S. N.; Lieutenant F. M. Barber, U. S. N.; Lieutenant R. R. Ingersoll, U. S. N.; Lieutenant Austin M. Knight, U. S. N.; Messrs. William Sellers, Charles A. Marshall, A. E. Hunt, M. J. Becker, William H. Burr, A. Gottlieb, Percival Roberts, Jr., Samuel Tobias Wagner, D. J. Whittemore, Joseph M. Wilson, Members Am. Soc. C. E., and Messrs. Henry M. Howe, John Coffin and John W. Langley, was read by the Secretary.

A discussion on the same subject was also presented and read by L. L. Buck, M. Am. Soc. C. E.

#### OF THE BOARD OF DIRECTION.

APRIL 27TH, 1887.—Applications were considered. Circulars prepared by the Special Committee of Arrangement for the next Convention, to be held at the Hotel Kaaterskill, Catskill Mountains, New York, were presented, approved, and their issue directed.

## THE NORMAN MEDAL.

## CODE OF RULES FOR ITS AWARD.

I.—Competition for the Norman Medal of the American Society of Civil Engineers shall be restricted to Members of the Society.

II.—There shall be one gold medal, and only one, struck for each and every fiscal year of the Society, and awarded as hereinafter provided. The dies therefor shall be with the Superintendent of the United States Mint at Philadelphia, in trust exclusively for the above purpose. Such medal shall be of a cost equal to the annual interest received upon \$1 000 of the Consolidated Stock of the City of New York, Certificate No. 179, of the additional new Croton Aqueduct Stock of the City of New York, authorized by an Act of the Legislature of the State of New York, Chap. 230, passed April 15th, 1870, dated November 17th, 1873, now held in trust by the Treasurer of this Society, and so held solely for this purpose, and shall be executed upon his order.

III.—All original papers presented to the Society by Members of any class, during the year for which the medal is awarded, shall be open to the award, provided that such papers shall not have been previously contributed in whole or in part to any other association, nor have appeared in print prior to their publication by the Society, nor have been presented to the Society in any previous year.

IV.—The Board of Censors to award the medal shall consist of three Members of the Society, to be designated by the Board of Direction. The Secretary of the Society shall act as Secretary to the Board of Censors.

V.—The medal shall be awarded to such paper as the said Board shall judge to be worthy of special commendation for its merits as a contribution to engineering science, not merely relatively as compared with others presented during the same year, but as exhibiting the science, talent or industry displayed in the consideration of the subject treated of, and for the good which may be expected to result from the discussion and the inquiry.

VI.—In case no paper presented during the year shall be deemed of sufficient value to receive an award, the amount of the interest of the fund for that year shall be expended by the Board of Direction in the purchase of books, to be offered as a premium for the second best paper in the next year in which more than one paper of sufficient value may be presented.

VII.—The medal year shall terminate on the first day of August, and the award shall be announced at the annual meeting.

VIII.—The Treasurer of this Society shall cause the medal to be prepared and delivered to, or deposited to the order of, the successful competitor, within two months after the annual meeting at which the same shall have been awarded.



## THE ROWLAND PRIZE.

### CODE OF RULES FOR ITS AWARD.

Not more than one prize shall be awarded each year for papers presented during the year. The year shall terminate on the first day of August, and the award shall be announced at the annual meeting in January.

The prize shall consist of fifty dollars in cash.

The award shall be made by a committee consisting of the Secretary and two Members of the Society, to be appointed by the Board of Direction.

The prize shall be awarded to such paper as the committee deem most worthy of such recognition, the preference being given to papers describing in detail accomplished works of construction, their cost and manner of execution, and the errors in design and execution.

### LIST OF MEMBERS.

#### ADDITIONS.

	MEMBERS.	Date of Election.
ANDREWS, HORACE.....	City Engineer, Albany, N. Y.	April 6, 1887.
DARLINGTON, FRANK GRAEF.....	(Elected Junior February 6th, 1884.) Superintendent Cincinnati and Muskingum Valley Ry., Zanesville, Ohio....	April 6, 1887.
DODGE, JOSEPH THOMPSON.....	Chief Engineer Montana Central Ry., Helena, Montana.....	April 6, 1887.
HERMANN, EDWARD ADOLPH.....	80 East New York st., Indianapolis, Ind.....	April 6, 1887.
JENNINGS, HENRY CLAY.....	Assistant Engineer Chicago, Milwaukee and St. Paul Ry., Milwaukee, Wis.....	April 6, 1887.
MORRILL, GEORGE SULLIVAN.....	Chief Engineer Old Colony R. R., Boston, Mass.....	March 2, 1887.
THOMAS, BENJAMIN FRANKLIN...	U. S. Assistant Engineer, Louisa, Ky.....	April 6, 1887.

#### FELLOW.

DARWIN, HARRY GILBERT .....	Glen Ridge, N. J.....	Mar. 22, 1887.
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## CHANGES AND CORRECTIONS.

## MEMBERS.

ADAMS, JULIUS W.....	Consulting Engineer, Dept, Public Works. 31 Chambers st., New York City.
BATES ONWARD.....	Edgemoor Iron Co., Wilmington, Del.
BECKWITH, L. F.....	Metropolitan Telegraph and Telephone Co. 144 Greenwich st., New York City.
BROWN, CHARLES O.....	17 Broadway, New York City.
CLARKE, THOMAS C.....	Union Bridge Co., 1 Broadway, New York City.
COHEN, MENDES.....	825 N. Charles st., Baltimore, Md.
CORTHELL, E. L.....	205 La Salle st., Chicago, Ill.
CROSBY, WILSON.....	New York, New Haven and Hartford R. R , Hartford, Conn.
DRAKE, W. A.....	Assistant Engineer Atchison, Topeka and Santa Fe R. R., Pueblo, Colo.
EARLEY, JOHN E.....	Chief Engineer Pacific Division Mexican Central Ry., Yrapuato, Mexico.
ECKERT, E. W.....	45 Broadway, Rooms 224 and 225, Aldrich Court, New York City.
FRITH, ARTHUR J.....	(Care Columbia Steel Co.) Columbus, Ohio.
HOWLAND, ARTHUR H.....	71 Equitable Building, Boston, Mass.
JACKSON, CHARLES E.....	15 Cortlandt st., Room 76, New York City.
PARKHURST, HENRY W.....	205 La Salle st., Chicago, Ill.
MACDONALD, CHARLES.....	Union Bridge Co., 1 Broadway, New York City.
MAN, ALBON P., JR.....	General Managing Agent Florida West Coast Improvement Co., Ocala, Fla.
REED, HORATIO G. H.....	Consulting Engineer Milwaukee, Lake Shore and Western Ry., Oshkosh, Wis.
RICE, GEORGE S.....	Executive Engineer Main Drainage Works. Boston, Mass.
RICHARDSON, THOMAS F.....	Division Engineer Chicago, Santa Fé and California Ry., Chillicothe, Ill.
RUDLOFF, HENRY F.....	237 West 14th st., New York City.
SMITH, HAMILTON, JR.....	5 Union Court, Old Broad st., London, England.
SNOW, J. PARKER.....	Woonsocket, R. I.
WRIGHT, AUGUSTINE W.....	(Care Citizens' Ry. Co.) 3820 Eastern Ave., St. Louis, Mo.

## ASSOCIATES.

BRADBURY, HENRY R.....	Manager Neuchatel Asphalte Co., Ltd., 265 Broadway, New York City,
PARSONS, GEORGE W.....	Pennsylvania Steel Co., Steelton, Pa.

## JUNIORS.

BISSELL, FRANK E.....	Chief Engineer Pan Handle Construction Co., Quanah, Tex.
CHAPIN, LOOMIS E.....	First Assistant City Engineer, Room 48, Pro- duce Exchange Building, Toledo, Ohio.
DAY, G. FREDERICK P.....	Box 298, Pasadena, Cal.
DURYEA, EDWIN, JR.....	Nebraska City, Neb.
FRANCIS, GEORGE B.....	Assistant Engineer New York, Providence and Boston R. R., Providence, R. I.
HAINES, CASPAR W.....	(Care H. S. Drinker.) 251 South 4th st., Philadelphia, Pa.
JOHNSON, S. J.....	Phoenixville, Pa.
JUST, GEORGE A.....	Engineer Jackson Iron-works, 315 East 28th st., New York City.
RUPLE, C. P.....	Wilson's Point, La.
SEAMAN, HENRY B.....	3205 Baring st., Philadelphia, Pa.
VAUGHAN, GEORGE W.....	Assistant Engineer New York, Chicago and St. Louis Ry., Cleveland, Ohio,
ZABRISKIE, AARON J.....	Assistant Engineer Newark's Improved Sewer- age, Rooms 84 and 85, Globe Building, Newark, N. J.

# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII.—May, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

MAY 4TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the Chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates were declared elected. As Members: Richard Milford Berrian, New York City; John Sterling Deans, Phoenixville, Pa.; John Addison Fulton, Kansas City, Mo.; Wilbur Francis Goodrich, Kokomo, Ind.; John Rogers Hudson, Pomona, Cal.; Frank Adolph Leers, Paterson, N. J.; John George Macklin, Peterborough, Canada; David Lowber Smith, New York City. As Associate: Robert James Pratt, Troy, N. Y. As Juniors: Edgar Bonaparte Gosling, New York City; Alfred Mitton Mosserop, Ithaca, N. Y.; Edward Walter Rathbun, Napanee, Canada; William Plumb Williams, New York City.

The death on April 19th, 1887, of Mr. Alexander Mitchell, F. Am. Soc. C. E., was announced.

An abstract of a paper by George F. Swain, Assoc. Am. Soc. C. E., on The Calculation of the Stresses in Bridges for the Actual Concentrated Loads, was read.

A paper by J. Albert Monroe, M. Am. Soc. C. E., on Novel Method of Removing Air from a Vertical Bend in a Suction Pipe, was read.

MAY 18TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the chair; John Bogart, Secretary.

A paper by A. J. DuBois, Jun. Am. Soc. C. E., on Formulas for the Weights of Bridges, was read and discussed by Messrs. J. A. L. Waddell, A. Gottlieb, Charles J. Morse, H. C. Jennings, Edwin Thacher, William M. Hughes, George H. Pegram, Charles E. Emery, W. H. Thomson, Members Am. Soc. C. E.; Palmer C. Ricketts, Assoc. Am. Soc. C. E.; and the author.

## OF THE BOARD OF DIRECTION.

MAY 25TH, 1887.—Applications were considered. Financial business was transacted.

## LIST OF MEMBERS.

## ADDITIONS.

## MEMBERS.

Date of Election.

BERRIAN, RICHARD MILFORD	....	Division Engineer Louisville Southern R. R., Shelbyville, Ky.....	May 4, 1887.
DEANS, JOHN STERLING	.....	Phoenix Bridge Co., Phoenixville, Pa.....	May 4, 1887.
GOODRICH, WILBUR FRANCIS	....	Resident Engineer Toledo, St. Louis and Kansas City R. R., Kokomo, Mo.....	May 4, 1887.
HUDSON, JOHN ROGERS	.....	Box 42, Pomona, Los Angeles Co., Cal. ....	May 4, 1887.

## ASSOCIATE.

PRATT, ROBERT JAMES	.....	Manager Electrical Works, Greenbush, N. Y., via Albany.....	May 4, 1887.
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## JUNIORS.

GOSLING, EDGAR BONAPARTE	....	106 West 73d st., New York City.....	May 4, 1887.
MOSSCROP, ALFRED MILTON	....	Instructor Department Civil Engineering, Cornell University, Ithaca, N. Y.....	May 4, 1887.

## CHANGES AND CORRECTIONS.

## MEMBERS.

FORNEY, M. N.	.....	45 Broadway, New York City.
KILLEBREW, SAMUEL	.....	Locating Engineer Mexican International Ry., Lerdo, Durango, Mexico.
MONROE, J. ALBERT	.....	Bismarck, Dakota.
RICHARDSON, B. FRANK	.....	Division Engineer Baltimore and Ohio R. R., 1531 South 13th st., Philadelphia, Pa.

## FELLOW.

MEYER, HENRY C.	.....	82 Fulton st., New York City
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# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII.—June, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

JUNE 1ST, 1887.—The Society met at 20 o'clock. President William E. Worthen in the chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates were declared elected. As Members: Frank Bruen, New Haven, Conn.; Henry Manson Byllesby, Pittsburgh, Pa.; Samuel Barrett Cushing, Providence, R. I.; Herbert Clark Felton, Camden, N. J.; Silas Bent Russell (elected Junior June 3d, 1884), St. Louis, Mo.; Robert Somerville, Greenville, Miss.; William Parsons Watson, Helena, Montana. As Juniors: Benjamin Douglas, Detroit, Mich.; Joseph Yendes Wheatley, New York City.

Some description of the German system of Permanent Way with Iron Substructure, prepared by the Secretary, and an abstract of a paper by George W. Rafter, M. Am. Soc. C. E., on the Study of the Biology of Water Supply, were presented and the subjects discussed.

JUNE 15TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the chair; John Bogart, Secretary.

Mr. J. L. Boulangé described the condition of the work on the Panama Canal.

#### OF THE BOARD OF DIRECTION.

JUNE 29TH, 1887.—Applications were considered. Appropriations were made. The arrangements for the Convention were discussed. It was ordered, under the provisions of the By-Laws, that the meetings of the Society be suspended during July and August, except the business meeting to be held during the Convention.

A communication from the Board of Street Openings of the City of New York, as to the opening and widening of Elm street, was presented requesting the appointment of a committee. The Board resolved that a committee should be appointed, and the President subsequently announced as such committee General George S. Greene, Messrs. William G. Hamilton and Stevenson Towle.

# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII.—July, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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### ANNUAL CONVENTION OF THE SOCIETY,

HELD AT HOTEL KAATERSKILL, N. Y., JULY 2D, 4TH, 6TH AND 7TH,  
1887.

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THURSDAY EVENING, JUNE 30TH.—An informal meeting was held at the House of the Society, New York, at which a large number was present. The detailed arrangements for the Convention were announced.

FRIDAY, JULY 1ST.—A steamer of the Albany Day Line was taken at 9 A.M., from New York to Rhinebeck; thence crossing the river to Rondout, the party proceeded by a special train *via* the Ulster and Delaware Railroad, the Stony Clove and Catskill Mountain Railroad, and the Kaaterskill Railroad, to the Hotel Kaaterskill, arriving late in the afternoon.

At an informal meeting the same evening, the President of the Society, Mr. William E. Worthen, presided, and the Chairman of the Convention Committee, Director William G. Hamilton, delivered an address of welcome.

#### FIRST SESSION.

SATURDAY, JULY 2D, MORNING.—The Convention was called to order at 10 o'clock by Mr. William E. Worthen, President Am. Soc. C. E. The provisions of the Society law relating to Conventions were read by Mr. John Bogart, Secretary Am. Soc. C. E. On the nomination of Mr.

William G. Hamilton, Chairman of the Committee, Mr. Thomas C. Clarke, M. Am. Soc. C. E., was elected Chairman of the Convention, and took the chair.

The subject of the Inspection and Maintenance of Railway Structures was discussed by written communications from Messrs. John A. Wilson, Willard S. Pope, E. S. Philbrick, C. A. Marshall, A. Lucius, E. P. Dawley, J. M. Goodwin, James G. Dagron and Joseph M. Wilson; and the subject was orally discussed by Messrs. D. J. Whittemore, Theodore Cooper, H. Stanley Goodwin, A. M. Wellington, Percival Roberts, Jr., C. C. Schneider, C. Frank Allen, John Bogart, Frederick Graff, R. I. Sloan, J. Foster Flag, J. J. R. Croes, William Kent, and Oberlin Smith.

#### SECOND SESSION.

JULY 2D, AFTERNOON.—The Second Session was held on the afternoon of Saturday, July 2d, Mr. T. C. Clarke, M. Am. Soc. C. E., in the chair.

A paper descriptive of An Economical Device for Destroying Disease Germs in Sewage was read by Mr. C. H. Schneider.

A paper on the Triple Thermic Motor, by Charles H. Haswell, M. Am. Soc. C. E., was read by the Secretary, and discussed.

A paper on Inspectors and Bridge-work, by Samuel Tobias Wagner, M. Am. Soc. C. E., was read by the author, and the subject discussed by Messrs. J. B. Johnson, A. M. Wellington, J. Foster Flag, F. Collingwood, Frederick Graff, J. J. R. Croes, Eliot C. Clarke. H. B. Seaman, and the author.

#### THIRD SESSION.

JULY 2D, EVENING.—The Third Session of the Convention was held on the evening of Saturday, July 2d. The President of the Society, Mr. William E. Worthen, delivered the Annual Address.

#### FOURTH SESSION.

MONDAY, JULY 4TH.—The Convention met at 10 o'clock, Mr. Thomas C. Clarke in the chair.

An illustrated description of the early American locomotive, DeWitt Clinton, was read by Mr. G. H. Thomson, M. Am. Soc. C. E., and discussed.

Mr. F. Collingwood, Chairman of the Committee on the Compressive Strength of Cements and the Compression of Cements and Settlement of Masonry, stated the progress made by that committee in their investigations.

A paper on the subject of Cements was read by Mr. W. C. Wetherhill, M. Am. Soc. C. E., and the subject was discussed by Messrs. D. J. Whittemore, F. Collingwood, William E. Worthen, John Bogart, E. B. Noyes, W. J. McAlpine, F. C. Prindle, J. F. Flag, E. P. North, W. C.

Wetherhill, E. Kuichling, G. S. Greene, P. P. Dickinson, and B. S. Church.

A paper descriptive of the Poughkeepsie Bridge, by Mr. John F. O'Rourke, M. Am. Soc. C. E., was read by the author, and discussed by Messrs. E. Kuichling, J. J. R. Croes, E. P. North, and F. Collingwood.

TUESDAY, JULY 5TH.—An excursion was made to Poughkeepsie, by invitation of the Union Bridge Company, and the progress of the erection of the bridge over the Hudson River at that point was inspected.

#### FIFTH SESSION.

WEDNESDAY, JULY 6TH, MORNING.—The Convention met at 10 o'clock. Mr. Robert E. McMath was elected Chairman for the remainder of the session on account of the necessary departure of Mr. T. C. Clarke.

A paper by Mr. F. P. Stearns, M. Am. Soc. C. E., on Sewage Disposal in Massachusetts, was read by the author.

A paper on Sewage Disposal, by Mr. C. A. Allen, M. Am. Soc. C. E., was read by the Secretary.

The subject was discussed by Messrs. Eliot C. Clarke, L. B. Ward, William E. Worthen, J. S. Schaeffer, B. S. Church, Oberlin Smith, F. P. Stearns, Robert Moore, E. Kuichling, William H. Wiley, R. E. McMath and E. P. North.

The subject of Technical Education was discussed by Messrs. R. H. Thurston, E. P. North, Oberlin Smith, Robert Moore, and A. M. Wellington.

#### SIXTH SESSION.

WEDNESDAY, JULY 6TH, AFTERNOON.—The session of the Convention was resumed in the afternoon, Mr. Robert E. McMath in the chair.

A paper on Cable Railway Propulsion on the New York and Brooklyn Suspension Bridge, by Mr. G. Leverich, M. Am. Soc. C. E., was read by the author, and the subject discussed by Messrs. Theodore Cooper, T. E. Brown, Jr., and L. B. Ward.

Mr. J. S. Schaefer, M. Am. Soc. C. E., described the Sewerage System of Newark, N. J., and the subject was discussed by Messrs. J. F. Flag, F. P. Stearns, E. Kuichling, William E. Worthen, W. J. McAlpine and Robert Moore.

In the evening the business meeting was held, the report of which is printed separately hereinafter.

#### SEVENTH SESSION.

THURSDAY, JULY 7TH, MORNING.—The Convention met at 10 o'clock, Mr. Robert E. McMath in the chair.

A letter from Mr. Charles Colné in reference to the progress of the



Panama Canal was read, and the subject discussed by Messrs. Robert Moore, William J. McAlpine, John Bogart and Theodore Cooper.

A discussion on the subject of the Vibration of Bridges, by Mr. T. H. Johnson, M. Am. Soc. C. E., was read.

A paper on Stresses in Bridges, by Mr. W. H. Booth, C. E., was read.

A paper on the Compressive Strength of Steel and Iron, by Mr. Charles A. Marshall, M. Am. Soc. C. E., was read.

A paper on the Strength of Bessemer Steel Compression Members, by Mr. J. G. Dagon, M. Am. Soc. C. E., was read.

A paper on the Kentucky and Indiana Bridge, by Mr. Mace Moulton, M. Am. Soc. C. E., was read.

A paper by Professor G. F. Swain, Assoc. Am. Soc. C. E., on the Calculation of the Stresses in Bridges for the Actual Concentrated Loads, was read.

Discussions on the paper printed in the Transactions, on the American Line from Vera Cruz to the City of Mexico, were presented by Messrs. O. F. Nichols and A. Bryson, Members Am. Soc. C. E.

#### EIGHTH SESSION.

THURSDAY, JULY 7TH, AFTERNOON.—The session of the Convention was resumed in the afternoon, Mr. Robert E. McMath in the chair.

Additional discussions on the subject of the Inspection and Maintenance of Railway Structures, by Messrs. George H. Pegram, J. A. L. Waddell, G. Bouscaren and G. Lindenthal, Members Am. Soc. C. E., were read, and the subject was discussed by Messrs. D. J. Whittemore, Robert Moore, and W. J. McAlpine.

The Convention then adjourned.

FRIDAY, JULY 8TH.—A visit to the Cement Mines and Works at Binnewater, Ulster County, N. Y., was made on invitation of Mr. F. O. Norton, F. Am. Soc. C. E., after which a train on the West Shore road was taken to New York.

The following 160 Members were in attendance at the Convention :

C. Frank Allen, Boston, Mass.; E. L. Abbott, Julius W. Adams, New York City, Horace Andrews, Albany, N. Y.; Charles Ackenheil, Elizabeth, N. J.; James Archbald, Scranton, Pa.; Thomas W. Baldwin, Bangor, Me.; Frederick Brooks, Boston, William S. Barbour, Cambridgeport, Mass.; John W. Bacon, Danbury, George H. Bishop, Middletown, Conn.; John Bogart, Henry R. Bradbury, Thomas E. Brown, Jr., Andrew Bryson, New York City, W. A. Brackenridge, Brooklyn, William F. Booth, Poughkeepsie, N. Y.; George Burnham, Jr., Philadelphia, Adolphus Bonzano, William H. Burr, Phoenixville, Arthur

Beardsley, Swarthmore, Pa.; C. P. E. Burgwyn, Richmond, Va.; C. N. Brown, Columbus, Ohio; George L. Burrows, Saginaw, Mich.; Eliot C. Clarke, Boston, Mass.; F. A. Calkins, B. S. Church, Thomas C. Clarke, Theodore Cooper, J. James R. Croes, New York City, C. L. Crandall, Ithaca, N. Y.; Francis Collingwood, Elizabeth, N. J.; Amory Coffin, Phoenixville, W. W. Card, Pittsburgh, Pa.; Mendes Cohen, Baltimore, Md.; W. D. Chapman, Akron, Ohio; Joseph P. Davis, P. P. Dickinson, Edward B. Dorsey, Stancliff B. Downes, C. Wheeler Durham, New York City; John S. Deans, Phoenixville, Charles Davis, Pittsburgh, Pa.; Frank G. Darlington, Zanesville, Ohio; E. W. Eckert, Charles E. Emery, New York City; M. T. Endicott, Norfolk, Va.; George D. Emerson, Rolla, Mo., Howard N. Elmer, St. Paul, Minn.; Frank L. Fuller, Boston, Mass.; J. Foster Flagg, New York City, C. E. Fogg, Poughkeepsie, George S. Field, Buffalo, N. Y.; Clark Fisher, Trenton, Herbert C. Felton, Camden, N. J.; Arthur J. Frith, Columbus, Ohio; Samuel M. Gray, Providence, R. I.; Edgar B. Gosling, G. S. Greene, Jr., New York City; Edward B. Guthrie, Buffalo, N. Y.; George S. Greene, Morristown, N. J.; Frederic Graff, Philadelphia, H. Stanley Goodwin, Bethlehem, Pa.; G. F. Haynes, Clemens Herschel, Frank W. Hodgdon, Boston, Mass.; Albert B. Hill, New Haven, Conn.; William G. Hamilton, Henry B. Hammond, William J. Haskins, New York City, Charles W. Hunt, New Rochelle, William E. Hoyt, Rochester, Edmund Hayes, Buffalo, N. Y.; John Houston, Jersey City, N. J.; J. D. Hawks, Frederick B. Howard, Detroit, Mich.; W. W. Hegeman, Ottumwa, Ia; Chauncey Ives, Chambersburg, Pa.; George A. Just, New York City; Washington Jones, Philadelphia, Pa.; W. H. Jennings, Columbus, Ohio; J. B. Johnson, St. Louis, Mo.; George A. Kimball, Boston, Mass.; Joseph M. Knap, New York City, Emil Kuichling, Rochester, N. Y.; Thomas C. Keefer, Ottawa, Canada; G. Leverich, South Orange, N. J.; O. E. Michaelis, Augusta, Me.; T. H. McKenzie, Southington, Conn.; George W. McNulty, New York City, William J. McAlpine, New Brighton, C. C. Martin, Brooklyn, James McNaughton, Albany, N. Y.; Thomas C. McCollom, Philadelphia, Mansfield Merriman, Bethlehem, Pa.; Henry G. Morse, Youngstown, Ohio; John MacLeod, Louisville, Ky.; Robert E. McMath, E. D. Meier, Robert Moore, St. Louis, Mo.; Albert F. Noyes, West Newton, Mass.; O. F. Nichols, Edward P. North, Ellis B. Noyes, New York City; Stacy B. Opdyke, New Haven, Conn.; F. S. Odell, New York City, John F. O'Rourke, Poughkeepsie, N. Y.; John A. Ockerson, St. Louis, Mo.; Henry A. Phillips, Worcester, Mass.; George H. Pegram, H. G. Prout, New York City, A. B. Paine, Poughkeepsie, N. Y.; Franklin C. Prindle, East Orange, N. J.; Joseph R. Richards, Boston, William Roberts, Waltham, Mass.; Palmer C. Ricketts, Troy, N. Y.; Samuel Rea, Paul S. Reeves, B. Frank Richardson, Percival Roberts, Jr., Philadelphia, Pa.; Benjamin Reece, Toledo, Robert L. Read, Cincinnati, Ohio; Samuel Rockwell, St. Paul,

Minn.; Frederic P. Stearns, George F. Swain, Boston, Mass.; C. C. Schneider, R. I. Sloan, D. McN. Stauffer, New York City; John H. Staats, Jersey City, John S. Schaeffer, Newark, Oberlin Smith, Bridge-ton, N. J.; E. Sweet, Albany, T. Guilford Smith, Buffalo, N. Y.; Henry B. Seaman, Samuel L. Smedley, Philadelphia, Pa.; Robert A. Shailer, Chicago, Ill.; Roger Tappan, Haverhill, Mass.; George C. Tingley, Providence, R. I.; G. H. Thomson, John Thomson, Calvin Tomkins, Stevenson Towle, Alfred W. Trotter, New York City, Robert H. Thurston, Ithaca, Harry Lee Van Zile, Albany, N. Y.; Frank O. Whitney, Boston, Mass.; Nelson J. Welton, Waterbury, Conn.; J. R. Wardlaw, S. S. Wheeler, A. M. Wellington, William H. Wiley, William E. Worthen, New York City, Charles D. Ward, Oswego, N. Y.; Lebbeus B. Ward, Jersey City, N. J.; Henry W. Wilson, Joseph M. Wilson, Philadelphia, Samuel Tobias Wagner, Phoenixville, Pa.; W. C. Wetherill, Savannah, Mo.; D. J. Whittemore, Milwaukee, Wis.; W. W. Walker, Cedar Rapids, Ia.

Ninety-one ladies of the families of Members accompanied them on the occasion of this Convention.

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#### MEETINGS OF THE SOCIETY.

JULY 6TH, 1887. (Business meeting during the Annual Convention at the Hotel Kaaterskill, N. Y.)—President William E. Worthen in the chair; John Bogart, Secretary.

Messrs. Edward P. North and Frank A. Calkins were appointed Tell-ers to canvass the ballot for membership and report at an adjourned meeting to be held in New York Wednesday, July 13th.

The report of committees being called for, the Secretary stated that the Chairman of the Committee on Uniform Standard Time was understood to be in Europe. On motion, that Committee was continued.

On motion, the Committee to Consider a Plan for a Library for Joint Use was continued.

The report of the Committee on the Proper Relation to Each Other of the Sections of Railway Wheels and Rails was called for.

MR. A. M. WELLINGTON.—MR. President: Mr. H. Stanley Goodwin, the Chairman, not being able to be here to-day, has instructed me to report on behalf of the Committee that we had hoped to submit a final report at this Convention, but owing to the large amount of material to be collated and to the time at command, we could not do so. We have collated a great body of statistics, including some of a very novel and interesting character which we are not aware have ever been brought together before. A striking example is that the records of the Pennsylvania Railroad for the past nine years show that wheels removed for sharp flanges on that road have the longest life of any of the eight or ten subdivisions under which the wheels removed are class-

ified, longer even than those worn hollow in tread. The Committee could easily have made a report showing a great deal of progress, but it appeared better to make no report until they could report in full, which they hope to do shortly, and ask to be continued.

The Committee was continued.

The Committee on the Compressive Strength of Cements and the Compression of Cements and Settlement of Masonry reported progress. The committee was continued.

The President announced that the next business in order would be the appointment of a committee to nominate officers for the ensuing year.

Mr. D. J. WHITEMORE.—Mr. Chairman and Gentlemen: I had the honor, although I was not present at Denver, of submitting a resolution which was met with favor by the Society. I move that the same course of procedure be taken as at the last Convention. I move that you read the action taken at the Denver Convention. Our selection of a Nominating Committee from different districts has however been rather indefinite; I understand that some of the Members have classified the membership in different districts, and perhaps it would be well to hear from them before final classification.

The Secretary read the resolution, as follows:

*Resolved*, That the Chairman of the Nominating Committee shall be a Resident Member who is a Past Officer or Director of the Society.

The resolution was carried.

Mr. ROBERT MOORE.—As I remember the action at Denver, which it may be well to follow, the names were all put on the board and then they were balloted upon, the five highest being elected.

Mr. J. P. DAVIS.—There always has been an attempt to have a committee chosen by geographical lines, but it has been done roughly. From a map showing the distribution of the Society which appears in the last issue of *Engineering News*, I have attempted to draw lines distributing the different Members equally.

Taking the Resident Members, there are about 200; taking the rest of New York State, New England and Canada, 207; New Jersey, Pennsylvania, Delaware, Ohio, Indiana and Michigan, 150; Illinois, Missouri, Wisconsin, Minnesota, Dakota, Nebraska, Washington Territory and Oregon, 150; all the rest of the States and Mexico, 144; that is about as well as the lines can be drawn.

Mr. WHITEMORE.—I suggest that we take a recess of five minutes, and those here from the several districts can select the persons to nominate from that district.

A MEMBER.—I move that the distribution of districts be as suggested by the list which Mr. Davis has collated from the distribution of the Society membership; that these be adopted as districts.

A MEMBER.—From how many districts are the committee chosen?

The SECRETARY.—Five, and Mr. Davis has five districts.

This motion was carried.

Mr. ROBERT MOORE.—It seems to me that putting up two or three nominations in each district for the consideration of the meeting is the better way. It may be that the local members might have a small representation here; that their nominations might not be the best.

Mr. THEODORE COOPER.—I think that it is clearly understood that the Nominating Committee is intended to be a method of feeling the Society in order to get nominations. The only way we can do this is to attempt to get a representative man from each district who can understand and know the feeling in his district. For instance, the gentlemen from New York State cannot select a man from Wisconsin or Missouri representing the feeling of the gentlemen who are Members in that district. It is better that the Members who are here from certain regions indicate who would be a representative man from that region. Of course this does not mean necessarily a nomination, it is an attempt to get the feeling of the Society. We have appreciated in the past that the Nominating Committee have not always been a representative body, but it is desirous to get such a body, and if there is a better way we should be glad to do it.

Mr. WHITEMORE.—I move that the Society take a recess of five minutes, that those present from the several districts may select names to put in nomination.

The motion for a five-minute recess was carried.

By request, the distribution list was again read, as follows:

- No. 1. Resident Members, New York City and 50 miles around it.
- No. 2. Rest of New York State, New England and Canada.
- No. 3. New Jersey, Pennsylvania, Delaware, Ohio, Indiana, Michigan.
- No. 4. Illinois, Missouri, Wisconsin, Minnesota, Dakota, Nebraska, Washington Territory, Oregon.
- No. 5. All the rest of the States and Mexico.

At the termination of the recess the meeting was called to order.

The PRESIDENT.—What is the nomination of District No. 1?

Mr. E. P. NORTH.—Mr. President: District No. 1 nominates WILLIAM H. PAINE.

The PRESIDENT.—District No. 2?

Prof. THURSTON.—District No. 2 nominates CLEMENS HERSCHEL.

The PRESIDENT.—No. 3?

Mr. OBERLIN SMITH.—District No. 3 nominates Mr. FREDERIC GRAFF.

The PRESIDENT.—No. 4?

Mr. WHITEMORE.—Mr. President: I am sorry to say that we are divided; we wish Mr. McMath, who is present, placed in nomination, and we have got Mr. McMath to agree that he will not put up another name. District No. 4 nominates Mr. R. E. McMATH.

The PRESIDENT.—No. 5?



Mr. MENDES COHEN.—No. 5 nominates Mr. BENJAMIN M. HARROD, of Louisiana, for one, and Mr. CHARLES H. LATROBE, of Maryland, for another.

The PRESIDENT.—How will you vote for these?

Prof. R. H. THURSTON.—I would like to ask for information. In some cases a single name is presented, and in others several. In the case of No. 2 there are alternatives not yet mentioned; shall we put up those alternatives, or shall we wait until we discover the result of the first ballot?

The SECRETARY.—The way it was done at Denver was this: Where there was but one candidate from a district, the question was put by a rising vote; where there were several candidates slips of paper were sent around, and the majority carried.

Prof. THURSTON.—In this case one name is presented and the others are presented as alternatives. My own idea is that they should be presented in this manner and one should be selected as the candidate, and the alternative presented if that name should not be accepted.

Mr. J. P. DAVIS.—Take a standing vote on each name presented and it will bring the thing all right.

Mr. Theodore COOPER.—I move that we take each district and vote in turn; I move that each district be balloted for.

Seconded and carried.

A vote was then taken and the following Members of the Society were duly elected as members of the Nominating Committee: Messrs. William H. Paine, Clemens Herschel, Frederic Graff, Robert E. McMath, Charles H. Latrobe.

Mr. ROBERT E. MCMATH.—For the purpose of taking the sense of this meeting, and perhaps eliciting some discussion, I offer the following resolution:

*Resolved*, That it is the sense of this meeting that it is expedient to create a grade of Students of the Society, said grade to consist of young men, over 18 and under 25 years of age, who are engaged in the study or practice of engineering. Connection with the Society to cease as each individual student reaches the age of 25, unless he shall be previously elected to a higher grade.

The purpose which we have in view in offering this resolution we regard as being a very important one in the policy of the Society. We all, I suppose, will agree that it is very desirable for the Society to increase its membership, provided such increase comes out of good and healthy material. When we recruit our membership from men in middle life they do not enter fully into the interest and work of the Society, and often they do not receive from it the benefit which they expect, and a great many of them allow their membership to lapse.

The fact that we have in mind is this: That by getting hold of young men who have decided to follow engineering as a profession—if

we can bring such young men into connection with the Society—it would cull from that class of young men many who, after obtaining the qualifications for advanced grades of membership, would take those grades, and, entering the Society from their earlier years, would take a deeper interest and remain connected with it throughout their lives; and by taking this class of young men we would be not only increasing, but would be invigorating the membership of the American Society of Civil Engineers with the young men who will be the prominent engineers of the future, and in this way we would advance and promote the interests of the Society, and of the young men also.

The idea we have is that this membership, this studentship, should confer upon the student the privilege of receiving the publications of the Society at a cost somewhere near the cost price. Aside from that they may have, such as are resident in the vicinity of New York, perhaps the privilege of attending the meetings, or of consulting the library. If so, of course, there should be a little difference between the dues of a Resident Student and a Non-Resident Student, as between a Resident and Non-Resident Member. In the young men who are thus brought into connection with the Society by receiving the Transactions, there would doubtless be brought out an interest which would remain through their lives. They would derive some little advantage to a certain extent from having their names in the list of Members, and thus being brought before the eyes of the men who are in the way of requiring the assistance of young men.

For these reasons I have introduced this resolution. I would like to hear the views of the Members of the Society, and would like to see a vote taken upon it.

MR. D. J. WHITEMORE.—If I could say anything that would add to the emphasis of what Mr. McMath has said I would do so. I would say I rise simply to second the motion.

MR. THEODORE COOPER.—Mr. President: A nursery is a necessity in every well regulated family, but there has to be connected with that nursery attachments that this Society does not possess.

It seems to me that it is another form of an idea which has been presented to our Society from time to time, tending to this result: Let down the bars, lower our requirements, obtain numbers. Mr. President: I don't think these things are desirable; we are not, as a Society, dependent upon numbers solely, and a movement simply to dilute ourselves with a mass of raw material will neither add to our dignity, our professional standing, or our scientific attainments. It means that we are to take a young man just free from the other nurseries and take him under our control. How are we to control him? What influence can we bring to bear upon him? Suppose we bring in 100 boys of eighteen, what kind of a pandemonium would we be liable to? What authority would we hold over them? None. They would

give the character and tone to our whole Society, whatever we might do. When this thing was presented before, I used an illustration which I think every one who has been a student will appreciate. Suppose among a group of young men some one should suggest, "Let's all go round to the Society of Civil Engineers and have a good time." We have all been boys; it is one of the most probable suggestions. Suppose one of the neighboring colleges should throw fifty young men into our Society, would it improve us much? Would it improve them? I think not, and I cannot see any purpose in this resolution.

Mr. A. M. WELLINGTON.—It is apparent to me that Mr. Cooper has spoken under a misapprehension of the purpose of this resolution, as I understand it. In the first place he does not know what has been done by other societies. This resolution is based upon the plan which has been in use in the Institution of Civil Engineers in England, and it is a well known fact that the great growth of that Institution started from the date of its adoption. In the Institution of Civil Engineers the students are about nine hundred in 5 000 members; they do not attend the annual meetings nor the weekly meetings, and as I understand this resolution, it does not contemplate admitting these students to the regular meetings. In London, whence this movement has started, the students have separate meetings of their own. We might never have students enough to hold separate meetings of their own, but this resolution does not contemplate that the students shall have the privilege of attending our meetings, unless by special invitation. As to any papers they may get up, if the Board of Direction thinks them sufficiently good, they are to be published in the Transactions. There have been papers prepared by young men—I can show Mr. Cooper a paper—I can show him several, I have no doubt, that have been prepared by some students of the Stevens Institute of Technology that show as good work as Mr. Cooper or myself have ever done. What is contemplated in forming this grade of students is that the students shall pay a certain due, and in return that they shall receive our Transactions. My own idea is about five dollars a year, something not much more than the net cost of publication. They have their names enrolled on the list, but the only privilege they get is the privilege of receiving the Transactions and such incidental advantages as may accrue from being connected with the Society. Any one who looks over the English papers will see that the student who desires an engagement states that he is Student of the Institution of Civil Engineers, and he gets it on that ground. They would receive our papers, and they would have the advantage, which is not purely an imaginary thing, of having a connection with the Society. Then, as I say, if there ever came a time that they wanted to hold meetings, they could hold them.

As to the addition of these students being a dilution, it is no more a dilution than is the addition of Juniors a dilution; but these students

would have no privilege, except that they pay their five dollars and receive our Transactions.

Mr. JOSEPH P. DAVIS.—If it is determined to make such a membership, it is going to require a considerable alteration of the Constitution, and I think a committee ought to be appointed to consider the whole subject and report to the Society.

The PRESIDENT.—Do you offer that as an amendment to the resolution?

Mr. DAVIS.—No, sir; I offer it as a suggestion.

Mr. COOPER.—As I understand this thing, it is, slightly boiled down, to sell to any student the Transactions for five dollars; that is as near as I can get at it. Mr. Wellington says the Society will publish any paper of sufficient merit prepared by these students; but the Society will publish, and has published, any acceptable papers by men who are not Members of the Society. If there are any of these young men who have papers that the Society will be glad to publish, we are prepared to do it; there is nothing to prevent any young man from presenting such a paper to the Society and getting the credit for it. Now, what is there left beyond selling our Transactions for five dollars? I will agree to it if that is all. Mr. Wellington compares the students in our country to the students of the Institution of Civil Engineers. I think the cases are entirely distinct. I understand that the students of the Institution of Civil Engineers are most of them apprentices of members of the Institution; they are not students of colleges, but they are men connected with the present members, what we call apprentices. We have not a grade of students. Mr. Wellington thinks it is the same thing, but it is not the same. A Junior is a student in one sense of the word, but he has accepted the profession by one year's practice in it. We have to define the class of students that we will not accept as Junior Members; they are the very men that Mr. Wellington wants to get in here for students that have not adopted the profession. That is my view of the distinction between the class of students and the class of Juniors.

Mr. OBERLIN SMITH.—I agree very thoroughly with the gentleman that this is a subject of such importance that it ought to be referred to a committee for further consideration; but as regards the thing itself, I do not feel any fear of watering our stock or diluting ourselves by connecting these young men with us; I think it would do us good. They would be getting information from the Transactions that they might not be able to obtain elsewhere; and it is for us, a great, strong Society banded together, made up of experienced men, to hold out a helping hand to the younger brothers; it does not do us any harm, and it may do us good. A connection of this sort would give them somewhat of *esprit de corps*, and with little trouble or expense to ourselves, it would give to these young men, just starting in life, a certain banding together that would be of advantage to them.

Mr. McMATH.—The idea was that this is a matter which takes hold on the policy of the Society, and that as such it was a matter of very considerable importance, and it was brought forward here at this meeting in order that the Members might all have an opportunity of knowing that a movement in this direction was on foot, and that they might carry that knowledge with them until the Annual Meeting, and anything in the shape of legislation could come up then; that is the way that former amendments to the Constitution have been presented; they must be presented by at least five Members not later than the first Wednesday in November. This is a talk to elicit the views of the Members; to know whether it is expedient to form this class of membership, or inexpedient. In our St. Louis local club we meet twice a month, about as you do. We extend an invitation to these meetings to the young men who are attending the technical school connected with Washington University. They don't meddle with our discussions, they just sit as listeners, and we scarcely have a meeting but that there are more or less of these young men present; they think very much of the privilege. But this plan is not necessarily connected with the adoption of this policy; the whole matter is simply to be left to the discretion of those who frame the legislation, and of course all restrictions can be placed round it. I do not think the Members of this Society are averse to taking any course which is likely to result in a very considerable increase of its membership that does not imply a letting down of the standard of membership; but rather, on the contrary, proposes a way of raising that standard.

Mr. W. G. HAMILTON.—I offer the following resolution:

That a committee of five be appointed by the chair to consider and report at the next Annual Meeting the advisability of adding a new grade of membership to be called "Students," and what alteration of the Constitution and By-Laws would be required to establish such a grade.

Mr. WELLINGTON.—I believe that that motion is entirely out of order; there is another motion before the house.

Prof. R. H. THURSTON.—I think our friend has not kept track of the changes that have occurred during the last thirteen or fourteen years since he was a young man.

Mr. COOPER.—Forty years.

Prof. THURSTON.—I realize how thoroughly in earnest our friend is, but great changes have occurred during this interval. I have had good opportunities to watch, during the past fifteen years, the changes going on in the education of young men for our profession, and I can see, from year to year, changes of very great importance. The young men who are coming now into our engineering schools are coming better prepared; they are coming to us vastly better fitted for their work. All the schools are continually throwing out from their ranks the worst students, those who do not come up to the standard. Whatever may be the opinion of my friend, I am sure that most excellent work is being



done at the technical schools. At the Troy Technical School, for instance, most admirable work has been done, and one noticeable circumstance has been the fact that they have done a great deal of this "throwing out." I saw a statement the other day that Harvard University was graduating a class of 250 students, and that not a man had been dropped from that class. An engineering school would not be considered to be doing the work such a school ought to do if a statement like that were made of it. If a school does not "throw out" it cannot be doing the very best work. This process of strengthening the ranks by throwing out the poorer material from among those who come in has been going on during this whole period. The result is that the work that is done by the other young men is often most admirable. This work is of such a nature as would do credit to any Member of our Society. I have in mind now a paper that was prepared by two young men which has been published in this country in several periodicals, republished in two or three of the French, and several of the German periodicals. Now work of that sort was not done twenty or thirty years ago. In the classes that come before me, I am quite sure that there has not been a class from among which I have not been able to select young men able to do work of permanency and value. Now this is not the kind of fellow who goes around for a good time; he does not drop in and drink his beer. He is earnest, he is competent. These young fellows would be delighted to have the opportunities that we might offer; many of them would be delighted to have the opportunity to read our Transactions and to consider themselves in some way connected with our Society, and they would honor us by their connection with us. I would like to see them at our meetings; I have not heard of a case in which that welcome was extended in which the young men did not prove to be the most attentive of listeners. The capacity of the average graduate of our good technical schools is extremely high as measured by the antiquated standards. I think we should be rejoiced to have the opportunity of welcoming such men, under proper restrictions, into our meetings, and I should be delighted to see their names upon our list.

The PRESIDENT.—Mr. McMath's resolution is before the house.

Mr. ROBERT MOORE.—I can see no reason why we should be afraid to undertake the course proposed, and I can see no reason why we should not take some such action as this resolution contemplates. I think that the difficulty may be met in some way, and that the connection will result not only in good to the young men who may avail themselves of this privilege, but that it will put in training a class of young men who would be a source of strength and honor to the Society. As the resolution contemplates, they will cease enjoying the privilege of this grade of membership at a certain time. If, in the process of time, it should seem unwise for them to go any further with us, that ends it;

but by that time we will know something about them, and they about us, and the step towards membership would be taken with much better advantage than if they had not passed through this stage. I can see no harm in it to anybody.

General G. S. GREENE.—Will you read the resolution again.

The SECRETARY read the resolution.

General GREENE.—Does that require any action by the officers of the Society?

The PRESIDENT.—No, sir; it is only an expression of the Society. Are you ready for the question?

A MEMBER.—I would suggest a rising vote.

The resolution was adopted; ayes, 34; noes, 11.

The PRESIDENT.—The motion is carried. Is there any other action that you want to take.

General GREENE.—I move that the resolution of Mr. Hamilton be taken up.

Mr. HAMILTON.—I withdraw my resolution.

General Greene adopted Mr. Hamilton's resolution as his own, which the Secretary read, and which was seconded.

The PRESIDENT.—Is there anything to be said on this?

Mr. B. S. CHURCH.—I would like an opportunity of seconding some of Professor Thurston's statements. Within the last two years I have employed some sixty young men directly from our institutions who have almost immediately had eminent responsibilities put upon them, and they have fulfilled them and carried them out to a degree of success that has surprised me. In some of the work on the Croton Aqueduct, lines from the outside were carried down the shafts in one of the tunnels (some three thousand feet having been reached) by these young men, some of them within three months after they commenced work, and none of these lines have struck outside  $1\frac{1}{4}$  inches.

By request, the Secretary again read the resolution, as follows:

"That a committee of five be appointed by the chair to consider and report at the next Annual Meeting the advisability of adding a new grade of membership to be called 'Students,' and what alterations of the Constitution and By-Laws will be required to establish such a grade."

Mr. E. P. NORTH.—I would like to ask, before that resolution is put: What is the method provided in the Constitution for proposing a change in the Constitution?

The SECRETARY read the provision.

Mr. NORTH.—I would like to amend that motion, that this Committee of five report, on or before the 1st day of November, the proposed change, if any, in the form of the Constitution, so that it can be submitted to letter ballot.

Mr. COOPER.—The amendment has to be proposed before November. The report of this Committee should be presented before November, in

order that the changes that they propose may be brought out and discussed at the Annual Meeting; so that resolution to be effective at the Annual Meeting must be presented before November.

The motion was amended so as to provide that the Committee report at the first meeting in October.

The PRESIDENT.—The resolution is as follows:

The SECRETARY read the amended resolution:

“That a committee of five be appointed by the chair to consider and report at the meeting on the first Wednesday of October, 1887, the advisability of adding a new grade of membership to be called ‘Students,’ and what alterations of the Constitution and By-Laws will be required to establish such a grade.”

This resolution was carried.

The President subsequently appointed the following members as such Committee: Messrs. Robert E. McMath, Robert H. Thurston, William H. Paine, Robert Moore and Fred. Brooks.

Mr. OBERLIN SMITH.—I have a resolution here to offer, which is in the same general line of thought as the last one; that is, in the way of improving the Society:

“*Resolved*, That the Board of Direction of the Society be requested to consider the advisability of appointing a standing committee on Technical Education and Professional Training, which should annually report to the Society the status and progress of such instruction in the United States, and Europe as well, together with such data, statistics and suggestions relative to the subject as may seem to them proper; said committee to co-operate with similar committees of other engineering societies, should such be appointed.”

I believe Mr. North has another to offer.

Mr. E. P. NORTH offered the following resolution:

“*Resolved*, That if created by the Board of Direction, such committee be desired to give especial attention to the matter of the formation and administration of those institutions known as ‘Land Grant Colleges,’ established by the several States under the ‘Morrill Bill of 1882,’ and report to what extent said colleges are carrying out the original ‘leading objects’ prescribed by that act of Congress; to what extent the funds donated under that law have been applied to such ‘leading objects;’ and to what extent, if at all, diverted from their original purpose, and further to report in what manner said funds may be, in the future, in the opinion of the committee, rendered most useful in the promotion of the industrial arts and the education of the industrial classes.”

Mr. MENDES COHEN.—Mr. President: It appears to me, sir, that the first resolution is entirely sufficient. This Society of Civil Engineers is instituted as an association of professional men for their advancement, for their professional improvement, etc., but I cannot see what we have got to do with investigating the educational institutions of the country, or why we should make any suggestions as to whether land grants have been properly applied. It seems to me that we would get ourselves into trouble. I can see no good in it whatever.

Mr. THEODORE COOPER.—I rather like this resolution in some respects. Of course my friend Professor Thurston says I am an old foggy. This is a continuation of the nursery question; we have taken the graduates of the nursery, now we are going back to see about the nursery itself. I think we ought to go to the nursery and see how many of the children there are able to enter our profession. It is a very interesting subject.

The PRESIDENT.—Suppose we take the sense of the Society on it. Is there anything more to be said on this matter?

Mr. ROBERT MOORE.—As I understand the resolution now, it is simply upon a committee to report on the matter of technical education. I rather think myself that it is laying out too big a work for any committee; perhaps we would hardly find a committee that is capable of accomplishing all that this resolution proposes; perhaps it would be just as well to restrict the operations of such a committee to our own country.

Mr. OBERLIN SMITH.—The gentleman is a little mistaken. It is not to appoint a committee, it is simply to ask the advisability of appointing such a committee, to see what they recommend in regard to looking up the land grant business. As to not extending it to Europe, Asia and Africa, I think there are technical colleges in Japan from which we might get a great deal of information. We might send out to the professors and instructors of the different colleges and get reports that would give a great deal of information; that could all be done by correspondence. The committee is not obliged to go and visit all these institutions, but a vast amount of information can be gathered through correspondence, and they are supposed to get all they can in this way. Then certainly a report to the Society of the condition of these institutions is going to be the means of a great deal of good. I intend to bring this subject up before the Society of Mechanical Engineers. We Members here have no idea of the immense importance of the educational business; we think these students don't amount to much. Fifteen or twenty years hence, when a good many of us are dead, these young men are going to be in the places that we are in now; if we can improve their education by anything that we can do now, it is going to help their education forward and undoubtedly is going to make a better class of engineers than there otherwise would be.

Mr. COOPER.—I would request the Secretary to read the first part of our Constitution, to let the Members here present know what the purpose of our Society is.

Secretary read from Constitution.

Mr. NORTH.—The point that Mr. Cooper makes there is "the advancement of engineering in its several branches." I see no better way of advancing engineering in all its branches than the insuring a good education to engineers. The only question is whether this Society should take an interest in it. One position is that the engineer is simply

a stake-driver; the other is that he is a man fitted by education and otherwise to take charge of work, and to direct not only the great forces of nature, but, to some extent, public opinion. I do not see why we should not take the action that is proposed in the first resolution, and I think that if we take up the first resolution, the second resolution follows it logically.

MR. A. M. WELLINGTON.—Mr. President: Our honored ex-President, Mr. McAlpine, calls attention to the fact that the Institution of Civil Engineers are taking part in this matter of the education of engineers. I would say for myself that I should think if general opinion in this Society could do any good in the matter of supervision in any way in regard to the conduct of technical schools, it seems to me very much within our field of usefulness; but I fail to see myself how a committee could do very much, how a committee could be very well expected to do much good in regard to this matter. As Professor Thurston has stated, engineering schools of to-day and those of twenty or thirty years ago are very different things. A man has got to give a great deal of attention to technical schools and everything relating to this matter to do anything in this line.

Prof. R. H. THURSTON.—Before the motion is put I will say one word. In regard to the Society taking hold of this matter, I suppose that it is within the province of a Society to take action with reference to the improvement of the profession. This Society should have been the first in this direction and should have taken up the subject years ago, but other people have been compelled to do this work. I received a few days ago a report from Dr. Woodward, which is one of the best reports upon this general subject of technical education. He states what is being done for technical education to-day; he has gathered facts not only in this country, but from other countries. This one man has done a good and useful work; could we not do as good work as this one man, who is not an engineer, has done, who gives facts and data of which we are ignorant? Why could we not seek such information and put it in such form as would be of profit to ourselves and others?

It marks a significant fact that the Baltimore and Ohio Railroad makes an annual appropriation of \$20 000 to secure a technical education for its apprentices, but in doing so that Company has taken a step that will do more for that railroad in the next generation than anything it could have done. We all know what the Pennsylvania railroad has accomplished.

A man who is shut up within four walls, however intelligent he may be, cannot keep himself posted in regard to what is going on in the outside world. I find it utterly impossible to keep posted as to the progress of engineering in my own branch. It is true that those who are established in colleges away from the great centers of the world can only get their knowledge of what is going on from reading the technical



periodicals; this kind of man cannot keep up in the truest sense with engineering progress; but he will accept a suggestion and profit by it. I believe that our schools have been doing good work; I believe that if we could have helped them by some such action as we are now considering they would have done better. I am absolutely sure that a committee can be chosen which can do this work most efficiently; I feel sure that the professors of engineering in several colleges in our own country will be ready to show just what they are doing in their work; and they will find the professors of French colleges equally ready. I have never applied to a professor in a French school but that I got what I wanted. I am sure that such a committee can do a vast deal of good.

If such a committee is formed it must look over the country very carefully, it must be very cautious in making statements, and it must look into the methods of administration of the great technical schools. In the schools like that at Troy there is less need of the suggestions this committee might offer, because the directors of such schools are men in the profession who know what is being accomplished in their lines, and how to carry on their work, but in the great mixed schools, such as the one with which I am connected, where we have departments of all kinds, there are bodies of men of such composition that the policy of the institution will easily tend towards the form of the older schools. Moreover, these funds are often in the hands of men who have no knowledge of the subject; they are often controlled by men who have other interests and know nothing whatever of the importance and value of technical education itself. Now if this Society, and other societies of the country, can afford to leave these ten or twenty or fifty millions to be misapplied, to be appropriated to the departments of literature and classical education, if this Society can afford to leave this enormous sum to be appropriated in this way, I presume the rest of the country can. This Society is precisely the body to take the initiative in a step of this sort.

On motion, the word "standing" was struck out from the first resolution.

The first resolution was then adopted; ayes, 25; noes, 9.

The subject was then, on motion, laid on the table.

Mr. D. J. WHITTEMORE.—My friend, Mr. H. Stanley Goodwin, who has been called away from the meeting, has sent this to me, to offer it at a proper time before the Society:

*Resolved*, That a committee of . . . . . Members of this Society be appointed by the President from among the Members skilled in designing, constructing and maintaining bridges, with the request that they prepare and suggest a plan and set of rules for inspection of railroad bridges. The same to be sent to each Member of the Society for criticism, and that the same, with the criticisms, be presented to the Society at the next Annual Meeting.

The disposition to be made of this resolution is that it should lay upon the table, to be taken up at any future moment. This resolution is from Mr. H. Stanley Goodwin.

The PRESIDENT.—It is moved and seconded that this motion be laid on the table.

The motion was carried.

The business meeting then adjourned to July 13th.

JULY 13TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the chair; John Bogart, Secretary. The Tellers reported the result of the canvas of the ballot for membership, and the following candidates were declared elected. As Members: John Ferris Alden, Rochester, N. Y.; Frank Milligan Ashmead, Hulton, Pa.; William Henry Breithaupt, (elected Junior, June 4, 1884,) Kansas City, Mo.; Henry Thompson Douglas, Baltimore, Md.; Ulysses Stanislaus Lutz, Bloomsburg, Pa.; James Moore Shanly, Montreal, Canada.

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## MEMOIRS OF DECEASED MEMBERS.

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ALEXANDER MITCHELL, F. Am. Soc. C. E.

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DIED APRIL 19, 1887.

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Alexander Mitchell became a Fellow Member of the American Society of Civil Engineers June 13th, 1883, and in his death, which occurred on the 19th of April last, the Northwest has lost one of its most prominent and successful business men, and one whose influence was known in all parts of the country.

The fact that Mr. Mitchell's name has for a number of years past been associated with those of the great financiers of the United States, and the position which he held as President of the Chicago, Milwaukee and St. Paul road, caused his decease to be regarded as a public calamity.

The subject of this sketch was born October 18th, 1817, in the Parish of Ellon, in Aberdeenshire, Scotland. His father, John Mitchell, was of



*Al. Mitchell*



English descent, while his mother was Scotch. Having lost his mother while yet a child, he grew up under the care of his father and his eldest sister, and received the usual common school education. On leaving school he entered a law office in Aberdeen, where he remained two years, leaving while still in his teens to assume a position with a banking house in Peterhead, where he acquired a business education and experience, which later was of great service to him. That this calling, affording as it did a peculiar field for the exercise of his talents, was well chosen, subsequent events have shown.

In 1839, on the solicitation of George Smith, a Scotchman then living in Chicago, Mr. Mitchell came to America. The preceding year Mr. Smith had secured the charter for the Wisconsin Marine and Fire Insurance Company, which was organized in the spring of 1839, and being familiar with the business ability and integrity of the young Scotchman, was anxious to secure his assistance.

In the territorial days of the Northwest, the many failures of irresponsible banks rendered the people exceedingly hostile to banking institutions, and when the Wisconsin Marine and Fire Insurance Company was organized, there were certain limitations in the charter regarding carrying on a general banking business, which, however, were so indefinite as to warrant their being totally disregarded.

Mr. Mitchell assumed entire control of this institution shortly after its organization, and Mr. Smith's connection with it was little more than nominal. Its business soon extended throughout the Northwest, and from the first its success was pronounced. In 1841, David Ferguson, also a native of Aberdeenshire, came to Milwaukee, and was made cashier of the bank. The fact that the circulation had increased from \$100,000 in 1843, to a million and a half in 1851, bears evidence to its rapid prosperity.

In 1844 a bill was passed by the territorial Legislature to repeal its charter, but the validity of the act was disputed under a decision of the Supreme Court, which held that a charter was a contract between the Government and the individual, which might be repealed only with the consent of both parties. Long litigation followed, but the credit of the institution remained unimpaired, and occasional runs upon the bank, caused by local panics, served only to exhibit its strength and the integrity and ability of its management.

In politics, Mr. Mitchell was first a Whig. He afterwards became a Republican, and during the war was an ardent supporter of the policy of the Government.

After the death of President Lincoln he advocated the reconstructive doctrines of Andrew Johnson, and in the reorganization of parties which followed became a Democrat. In 1868 he supported Horatio Seymour, the Democratic candidate for the presidency, and was himself the congressional candidate of the same party in the first Wisconsin District.



He was defeated that year, but in 1870 again accepted the nomination, and was elected by a large majority. In 1874 he declined to become a candidate for another term.

He was chosen one of the Wisconsin delegates to the National Democratic Convention in 1876, and supported Samuel J. Tilden for the presidency. The Democratic State Convention tendered him the nomination for Governor in 1874, but Mr. Mitchell declined to become a candidate. In politics he was conservative and independent, advocating those measures which he believed to be for the good of the country rather than blindly following party leaders.

In the present article, however, we shall devote more space to Mr. Mitchell's career as president of a great railway than as a financier, for while his position was no less important in the former than in the latter character, identification with the financial interest of a country is more apt to attract attention from the public than is any connection with a special enterprise, however great it may be.

For a number of years past, Mr. Mitchell's position as chief executive officer of the St. Paul system gave him a prestige which few men have an opportunity of enjoying, but notwithstanding this fact, the active interest which he took in building up the railroads of the Northwest in the early days is known to few.

In 1839, when Mr. Mitchell became a resident of Milwaukee, the population of the place did not exceed 1 500, while that of the whole territory included within the limits of what is now the State of Wisconsin was less than 30 000. The credit of Milwaukee after the panic of 1857 was greatly impaired. The railways at that time tributary to the city were bankrupt; and among the other bonds issued by the municipality to the companies were \$200 000 to the La Crosse and Milwaukee Railroad, which was then in the hands of a receiver. A large amount in bonds had already been issued to the Milwaukee and Mississippi Railroad Company, but on its reorganization a settlement was affected by which the city secured stock in the Milwaukee and Prairie du Chien road. There still remained about \$900 000 in railway bonds on which the interest was in default, and the several corporations were unable to aid in their payment.

The various railroads in Wisconsin at this time were small and owned by separate and weak companies. They had been built with the aid of town and county bonds and were heavily mortgaged. They were operated independently, and, as a consequence, their running expenses in every instance were in excess of their incomes.

Early in the sixties the condition of the railways had become such that foreclosure proceedings were begun in the Courts, whereupon the titles to much of the railroad property in the State became so involved that the outlook was exceedingly gloomy, and for some time it seemed as if the roads would be compelled to cease operations.

The principal companies in this condition were the Milwaukee and Prairie du Chien, the La Crosse and Milwaukee, the Milwaukee and Watertown, the Milwaukee and Horicon, and the Western Union, running from Racine to Freeport, Ill.

While the crisis was threatening in railroad and commercial affairs, an arrangement was effected with Mr. Mitchell by which the bondholders of the several roads joined themselves with him for the purpose of protecting and improving their property. A plan was accordingly arranged to consolidate and operate the roads as a single system. The first road secured was the La Crosse and Milwaukee, together with the Horicon line, and when the Milwaukee and Watertown road, running to Columbus, was purchased shortly afterwards, the Milwaukee and St. Paul Railway Company was formed (May, 1863). Alexander Mitchell was elected President, an office which he held until his death, and S. S. Merrill was chosen General Manager, a position which he ably filled until his decease in 1885.

Shortly afterwards the Prairie du Chien line was secured, and the Iowa and Minnesota roads were added to the St. Paul system; the connections throughout the State were built, and the Chicago Division was constructed (1871-72), the Western Union and the Chicago and Council Bluffs were consolidated with the main line, and an extension was built into Dakota. In 1874 the name of the corporation was changed to the Chicago, Milwaukee, and St. Paul Railway Company, and at the present time it owns more miles of road than any other company in the world. When the scheme of consolidating was in its incipency the stock was almost worthless, while it has recently been quoted at almost its face value.

That the success of the St. Paul road is in no small degree due to the energy, sagacity, and daring of its first President, few who are familiar with the course of events in the Northwest will deny, for while the demands of trade, the rapid increase in population, and the vast resources of the territory about the head waters of the Mississippi and the Great Lakes at the present time render the successful accomplishment of commercial enterprises much less doubtful, the condition of affairs in 1850 was far otherwise, and the assumption of responsibilities such as the management of the bankrupt railroads entailed, implied a determination and courage which have not been exercised in vain.

In 1869, Mr. Mitchell accepted the presidency of the Chicago and Northwestern Railway Company, but resigned on the expiration of the year, as he believed it to be to the interest of the two parallel lines to be under different control.

He was naturally and unconsciously dignified in presence; in business his word was always the equivalent of his bond. Trickery or chicanery in either political or commercial transactions always received his condemnation.

Socially he was strongly attached to old time friends, and a kind greeting was always extended to the young who sought his advice or assistance. His domestic relations can best be expressed in the words of his son when asked immediately after his death as to his characteristics traits said, "I can now only remember him as a kind, indulgent and affectionate father."

Avoiding ostentatious charity, the writer believes it can be truthfully said that no case of deserving distress, public or private, was ever properly brought to his attention without receiving substantial relief.

To the engineer who had continuous charge of the great work of which Mr. Mitchell was the executive head, he was a model President, giving him his hearty support in all that related to public safety. When asked if he would become a Fellow Member of the American Society of Civil Engineers, he promptly answered, I shall consider it an honor to have my name associated in so far as I am eligible with that Society, the Members of which have performed so much in developing the industries of this continent.

## LIST OF MEMBERS.

### ADDITIONS.

MEMBERS.	Date of Election.
BRUEN, FRANK ..... 31 and 32 Insurance Building, New Haven, Conn.....	June 1, 1887.
CUSHING, SAMUEL BARRETT.... 21 South Main st., Providence, R. I. ....	June 1, 1887.
FULTON, JOHN ADDISON..... Resident Engineer Chicago, Santa Fé and California R. R., Bucklin, Mo. ....	May 4, 1887.
FELTON, HERBERT CLARK ..... Superintendent and Treasurer Kaighus Point and Philadel- phia Ferry Co., Camden, N. J. ....	June 1, 1887.
LEERS, FRANK ADOLPH..... Engineer Passaic Rolling Mill, Paterson, N. J. ....	May 4, 1887.
MILLER, SILVANUS, Jr..... (Care Miller & Coates.) 279 Pearl st., New York City.....	March 2, 1887.
MORRIS, SAMUEL FISHER..... Box 790, Yonkers, N. Y. ....	April 6, 1887.
RUSSELL, SILAS BENT..... (Elected Junior, June 4, 1884.) Water Commissioners' Office, St. Louis, Mo.....	June 1, 1887.

MEMBERS.		Date of Election
SHEARER, SAMUEL HENRY.....	City Engineer, Rooms 10 and 12, Court House, Indianapolis, Ind.....	Jan. 5, 1887.
SIMPSON, GEORGE FREDERICK ..	310 West 134th st., New York City.....	March 2, 1887.
SMITH, DAVID LOWBER.....	Deputy Commissioner Depart- ment of Public Works, 70 West 83d st., New York City..	May 4, 1887.
SOMERVILLE, ROBERT,.....	Assistant Engineer Mississippi Levee Commission, Greenville, Miss.....	June 1, 1887.
WATSON, WILLIAM PARSONS ...	Montana Central Ry., Butte, Montana.....	June 1, 1887.

## JUNIORS.

DOUGLAS, BENJAMIN .....	Chief Engineer's office, Michigan Central Ry., Detroit, Mich...	June 1, 1887.
HAYNES, GIDEON FREDERICK ...	10 Tremont st., Boston, Mass...	April 6, 1887.

## ASSOCIATE.

WHEATLEY, JOSEPH YENDES....	Assistant Engineer New York Central and Hudson River R. R., Room 21, Grand Central Station, New York City.....	June 1, 1887.
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## CHANGES AND CORRECTIONS.

## MEMBERS.

BALDWIN, FRED H.....	Principal Assistant Engineer Union Elevated R. R., 31 Sands st., Brooklyn, N. Y.	
BARNARD, AUGUSTUS P.....	U. S. Coast Survey, Lawrence, Kansas.	
BOUSCAREN, LOUIS G. F.....	Consulting Engineer, 99 West 4th st., Cincin- nati, Ohio.	
BRODHEAD, CALVIN E .....	Lock Box 595, Scranton, Pa.	
CALKINS, FRANK A.....	84 Fulton st., New York City.	
CHAPHE, A. J.....	917 Primrose st., St. Louis, Mo.	
CORNELL, GEORGE B.....	Chief Engineer Union Elevated R. R., 31 Sands st., Brooklyn, N. Y.	
CRAIG, C. M .....	Engineer in charge Blakely Extension Cen- tral R. R., Blakely, Ga.	
DARRACH, CHARLES G.....	435 Chestnut st , Philadelphia, Pa.	
GRISWOLD, FRANK L.....	80 Calle Constitucion, Cordoba, Argentine Republic.	
HARISON, R. MORLEY.....	99 Douglas st., Glasgow, Scotland.	

HAVEN, WILLIAM A.....	West Medford, Mass.
HEALD, S. C.....	31 Milk st., Boston, Mass.
HUNT, RANDELL.....	Bridge Engineer Chicago, St. Paul and Kansas City Ry., 363 Dayton ave., St. Paul, Minn.
LEDERLE, GEORGE A.....	Resident Engineer Willamette Bridge, Oregon Railway and Navigation Co., Portland, Oregon,
MYERS, CHARLES H.....	2775 Third ave., New York City.
PLYMPTON, GEORGE W.....	127 Herkimer st., Brooklyn, N. Y.
POST, JAMES C.....	Major Corps of Engineers U. S. A., Washing- ton, D. C.
POU, ARTHUR.....	Chief Engineer Savannah, Dublin and West- ern Short Line Ry., Savannah, Ga.
PRATT, WILLIAM A.....	Engineer Maintenance of Way Philadelphia Division, Baltimore and Ohio R. R., Wil- mington, Del.
PROUT, HENRY G.....	Editor <i>Railroad Gazette</i> , 73 Broadway, New York City.
PURDON, CHARLES D.....	Grand Tower, Ill.
RICHARDS, H. T.....	Assistant General Manager Sonora R. R., Guaymas, Sonora, Mexico.
RUGGLES, WILLIAM B.....	Harrodsburg, Ky.
RUTHERFORD, F. M.....	Assistant Engineer and Roadmaster Anniston and Atlantic R. R., Anniston, Ala.
SCHAEFFER, JOHN S.....	Globe Building, Room 85, Newark, N. J.
SCHUYLER, JAMES D.....	Chief Engineer National City Water-works, San Diego, Cal.
SHEDD, J. HERBERT.....	74 Westminster st., Providence, R. I.
THACKRAY, GEORGE E.....	P. O. Box 789, New York City.
VAN SANT, ROBERT L.....	(Care Chief Engineer St. Louis and San Fran- cisco R. R.) North Springfield, Mo.
WARD, JOHN F.....	291 Montgomery st., Jersey City, N. J.
WILDER, F. M.....	160 Broadway, New York City.

## JUNIORS.

FULLER, FRANK L.....	12 Pearl st., Rooms 35 and 36, Boston, Mass.
HAVILAND, ARTHUR.....	Kampmann Building, Room 33, San Antonio, Texas.
LUCAS, D. JONES.....	143 East 59th st., New York City.
VAN ZILE, HARRY LEE.....	55 North Pearl st., Albany, N. Y.
YATES, PRESTON K.....	Chief Engineer Natchez Water Co., Natchez, Miss.



# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII, August, 1887.

NOTE.—No meetings of the Society were held during the month of August, 1887.

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## MEMOIRS OF DECEASED MEMBERS.

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CHARLES SHALER SMITH, M. Am. Soc. C. E.

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DIED DECEMBER 19th, 1886.

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Charles Shaler Smith was born in Pittsburgh, Pa., January 16th, 1836. His father, Frederick Rose Smith, died when the son was but nine years of age; and his mother, Mary Anne Shaler Smith, died when he was sixteen.

Prior to this time he had attended a private school at Pittsburgh, but with his mother's death his days of formal schooling ended, and his years of work, which were at the same time always years of study, began. He entered the same year, 1852, upon the study of his profession by taking a position on the Mine Hill and Schuylkill Haven Railroad as rod-man, from which position he was presently promoted to that of leveler.

After this we next hear of his employment in surveys at Pittsburgh, and then, in 1854, in railroad surveys in the mineral regions of Lake Superior.

His final term of pupilage was in the service of the Louisville and Nashville Railroad, which he entered in 1855 as an assistant with the late George MacLeod, then chief engineer. His first work in this new field was on the relocation of the road in Tennessee. In the spring of 1856 he was employed on the Memphis Branch, and then on the Tennessee Division of the main line in charge of a residency on construction. In 1857 he was transferred from the field to the office of the chief engineer at Louisville, being assigned to duty as an assistant to Mr. Albert Fink, engineer of bridges and buildings. In the spring of 1859 Mr. Smith had

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Committee to prepare memoir, Messrs. John MacLeod, Robert Moore, and Onward Bates.

charge of the track and bridge construction on the Memphis Branch, and in October of the same year he left the service of the Louisville and Nashville Railroad to enter that of the Wilmington, Charlotte and Ruthersford Railroad in North Carolina as chief engineer of bridges and buildings, where he remained until the breaking out of the war.

He at once entered the army of the Confederacy as a captain of engineers, and remained in the service until the close of the war in 1865. During this period, as chief engineer of government works in the Augusta District, he constructed the Confederate States powder works with a daily capacity of 17 000 pounds of powder and one of the largest that had then been built.

At the close of the war he was married, May 23d, 1865, to Miss Mary Gordon Gairdner, of Augusta, Ga., and remained for a time in the South as an engineer of bridges. During this time he built the Catawba and Congaree bridges on the Charlotte and South Carolina Railroad, in South Carolina. These were of the Fink type and remained in service twenty years, when they were replaced by others adapted to the heavier engine and train loads of the present day.

In 1866, Mr. Smith organized, with Charles H. Latrobe and his father, the late Benjamin H. Latrobe, the engineering firm of Smith, Latrobe & Co., which in 1869 became the Baltimore Bridge Company, with Mr. Smith as president and chief engineer. This company remained in business until 1877, and did a large amount of work.

In 1868, Mr. Smith removed from Baltimore with his family to St. Charles, Mo., to take charge, as chief engineer, of the railroad bridge then just begun at that point over the Missouri River.

In 1871, upon the completion of the bridge at St. Charles, he changed his residence to St. Louis, where he remained until his death, which took place December 19th, 1886, after an illness of nearly two years.

Few engineers of his time have done as much work as Mr. Smith. The bridges built under his supervision number hundreds of structures and miles of track, and include four bridges over the Mississippi, one over the Missouri, and one over the St. Lawrence. Some of them mark eras in this department of engineering, for he had both the ability and the courage to leave precedent behind him, and some of his structures have permanently increased the resources of his profession.

Among his contributions to engineering knowledge may be noted the use of iron trestle-work, which he was the first to employ on any large scale, by building, in 1868 and 1869, on the Louisville, Cincinnati and Lexington Railroad, and the Elizabethtown and Paducah Railroad, nine structures of this class ranging from 50 to 135 feet in height.

But his most important professional work was without doubt the practical demonstration of the uses and value of the cantilever, in the employment of which he was, in this country at least, the pioneer. His first use of the cantilever as a means of dispensing with false-work was

in 1869, when he erected in this manner a 300-foot draw span over Salt River, on the line of the Elizabethtown and Paducah Railroad. His next work of this kind was the Kentucky River bridge on the Cincinnati Southern Railroad.

This crossing was located by the railway engineers at a point where over twenty years before, Mr. John A. Roebling had built the towers for a suspension bridge, and where the cañon through which the river runs is 1 200 feet wide and 275 feet deep. The river here is subject to freshets which average one every two months, with a maximum range of 55 feet and a known rise of 40 feet in a single night. Plans, accompanied by tenders for the construction of the bridge, were received by the railway engineers from a number of competitors. The design for a cantilever structure, submitted by Mr. Smith, seemed to be the best solution of the problem and the contract was accordingly awarded to him.

This structure is remarkable for the boldness of its design and the faith of its engineer in his ability to plan and execute a work for which there was no precedent, and no guarantee of success except the correctness of his calculations. Mr. Smith staked his professional reputation on his design and undertook the execution of the work at his own pecuniary risk. His success is a brilliant illustration of the exact science of the profession, and demonstrates the completeness of his own mastery of its principles.

The bridge consists of three spans of 375 feet each, carrying a railway track at a height of 276 feet above the bed of the river. At the time of its construction this was the highest railway bridge in the world, and it is still the highest structure of the kind with spans of over 60 feet in length. The bridge is supported by the bluffs at its ends and by two intermediate iron piers resting upon bases of stone masonry. Each iron pier is 177 feet high, and consists of four legs, having a base of  $71\frac{1}{2}$  by 28 feet, and terminating at its top in a turned pin 12 inches in diameter under each of the two trusses. Each iron pier is a structure complete in itself, with provision for expansion and contraction in each direction through double roller beds interposed between it and the masonry, and is braced to withstand a gale of wind that would blow a loaded freight train bodily from the bridge.

The trusses were commenced by anchoring them back to the towers built by Roebling, and were then built out as cantilevers from each bluff to a distance of one-half the length of the side spans, and at this point rested upon temporary wooden supports. From thence they were again extended as cantilevers until the side spans were completed and rested upon the iron piers. Similarly the halves of the middle span were built out from the piers, meeting with exactness in mid-air. The temporary support used first at the center of one side span and then at the other, was the only scaffolding used in erecting the structure, none whatever being used for the middle span.

When the junction was made at the center of the middle span, the trusses were continuous from bluff to bluff, and had they been left in this condition would have been subjected to constantly varying strains resulting from the rise and fall of the iron piers due to thermal changes. This liability was obviated by cutting the bottom chords of the side spans and converting them into sliding joints at points 75 feet distant from the iron piers. This done, the bridge consists of a continuous girder 525 feet long, covering the middle span of 375 feet, and projecting as cantilevers for 75 feet beyond each pier, each cantilever supporting one end of a 300-foot span, which completes the distance to the bluff on each side. The trusses being of the Whipple, or double intersection type, in order to remove all doubtful action at the hinging points, the two web systems are concentrated into one through the intervention of a short link with a pin at each end.

Mr. Smith's calculations were verified from beginning to end by the actual results of this great work, which is of itself sufficient to confer upon him lasting fame as an engineer.

In 1880, Mr. Smith designed and constructed another cantilever bridge for the Chicago, Milwaukee and St. Paul Railroad, over the Mississippi River, near St. Paul. This structure consists of two side spans of 270 feet each, and a middle span of 324 feet. The side spans were erected on scaffolding, but none were used for the erection of the middle span, which was built out from each side as two cantilevers, meeting at the center. In this span the bottom chords are continuous throughout its length, whilst the top chords are cut at the center and arranged with sliding joints.

Another novel feature of this bridge is that the piers are of iron, hinged at top and bottom. Provision for the expansion and contraction of the whole three spans is made at the shore ends of the side spans.

Mr. Smith's last great work is the bridge just completed over the St. Lawrence River, for the Canadian Pacific Railway, a short distance above the Lachine Rapids. In this bridge the conditions of the location led him again to apply the cantilever principle, but upon a design entirely novel. This is a deck bridge, except over the main channel, where a high or through bridge was required to permit the passage of steamers. The depth and strength of the current at this point is such as in the judgment of the engineers to preclude the use of scaffolding.

Mr. Smith provided for the clear headway of 60 feet for steamers, and the erection without scaffolding over the deepest water by what he denominated "flying cantilever" spans, arranged as follows: A distance of 1355 feet 8 inches over the main channel is crossed by two deck flanking spans and two central cantilevers through spans of 408 feet each. The change from deck to through spans is made by curving the top and bottom chords of the cantilever spans upward from the flanking spans, and the bottom chords upward from the central pier. In erecting, the

cantilever spans were to be built out each way from the flanking spans and from the central pier without the use of scaffolding. When the connection is made in the centers of the cantilever spans, the joints are to be riveted up so that they will act as cantilevers for dead load and as continuous girders for live load. The cantilever spans are fixed at the central pier, and the play of expansion and contraction is taken up at the further ends of the flanking spans. Vertical adjustments are provided for at the ends of the flanking spans to release any abnormal strains which may be caused by the settlement of the piers.

During the preparation of the plans for and the execution of this work, Mr. Smith was an invalid, confined to his room and suffering extreme bodily pain. But his strong will mastered his physical suffering, and he kept himself informed of the progress of his work and held the direction of it until the very end of his life. This structure is one of the greatest works of its kind, and is a worthy ending of a professional career of exceptional brilliancy.

Mr. Smith's time was so engrossed by the large amount of work under his care that he had no time left to make a record of it. There is not a line written by himself descriptive of any of his works, although many of them would have been rich in lessons for the rest of the profession if he had but written them out. A pamphlet of 55 pages, published in 1865, entitled "A Comparative Analysis of the Fink, Murphy, Bollman and Triangular Trusses;" an article in the Transactions of the Society for 1877, on the "Proportions of Eye-bar Heads and Pins as Determined by Experiment;" another in the Transactions of the Society for 1880, on "Wind Pressure upon Bridges;" and several brief discussions of papers presented by others, comprise nearly all that he has written. All show the great care and skill with which he studied facts, and intensify our regret that he did not put more of his results upon record.

During the early portion of Mr. Smith's career as a bridge engineer the building of iron bridges was a new art; the number of contractors with the necessary skill and experience to undertake important works was small; and the present efficient tools and plants which have resulted from the necessities of improved designs did not exist; so that, in the practice of his specialty, Mr. Smith was almost compelled to undertake, as a contractor, the execution of his own designs. A large number of his works, and some of the most important of them, were executed by him as the contractor. During the last few years of his life however, nearly the whole of his practice was in the capacity of consulting engineer, acting as such for the St. Louis Bridge Company, the Canadian Pacific Railway, and several of the largest Western railway systems.

By all those who enjoyed the privilege of an intimate acquaintance with him, Mr. Smith will be remembered even longer for his personal traits than for his ability as an engineer. Owing to his modesty and a certain reserve which grew out of it, it took a little time



to break the crust and get at the real man beneath. But when this was done the reward was great. With his friends he was the most genial of companions. Flashing with wit and possessing a varied and extended fund of knowledge, he was always entertaining upon any subject in which others were interested. With his friends he was open as the day. He had no trade secrets, but his knowledge and experience were always at the service of a professional brother.

He was fond of field sports, though his professional duties permitted little indulgence in them. On dogs, guns, boats, and other like remedies for the over-worked man he was an authority, and a day's outing with him was something to be long remembered. An ardent lover of nature, every object, animate and inanimate, was caught by his keen eye, and he would draw attention to it in a way that never failed to excite interest and leave behind a pleasant remembrance.

His own transparent integrity unfitted him somewhat from dealing with others not of the same sort, and interfered at times with his success as a business man. He could not understand a knave, and he was a frequent sufferer financially because of his unwillingness to believe that others would not be governed by principles of honor as inflexible as his own.

Nothing better revealed the real spirit of the man than his treatment of his subordinates, to whom he was always a model of courtesy and thoughtful consideration. He was accessible to all, and no one was of too humble station to approach him. His office was a favorite school for young engineers, by whom his assistance was always at command. Many who read these lines will recall times when he has put aside his own affairs that he might give his time to them. From the highest to the lowest of his employees all were devotedly attached to him, and no stronger testimony to his personal worth can be offered than the loyal and abiding friendship of every person who was ever in his service.

Mr. Smith became a Member of the American Society of Civil Engineers March 5th, 1873, and was a Director of the Society from November, 1877, to November, 1878.

# American Society of Civil Engineers.

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## PROCEEDINGS-

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Vol. XIII.—September, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

SEPTEMBER 7TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the Chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates were declared elected. As Members: Calvin Harlow Allen, New York City; Robert Bunker Coleman Bement, St. Paul, Minn.; Peter Franklin Brendlinger, Pottsville, Pa.; Alba Fisk Brown, Pittsburgh, Pa.; George Devin, New York City; Roscoe Edwin Farnham, Chicago, Ill.; Charles Hallet Graham, New York City; Charles Harlowe, Boston, Mass.; David Christiaan Henny, Boston, Mass.; Edward Willard Howe, Boston, Mass.; William Dunbar Jenkins, Kansas City, Mo.; Horace Greeley Johnston, Salina, Kan.; Alfred Potter Kirtland, Blairsville, Pa.; Frederick Nash Owen, New York City; Alfred Holden Simpson, Newport News, Va.; Otto Frederik Sonne, Orrick, Mo.; William Starling, Greenville, Miss.; Alfred Thomas Tomlinson, Badger, Colo.; Francis Stuart Williamson, Jersey City, N. J. As Juniors: Julius Baier, St. Louis, Mo.; Gilbert James Bell, Orrick, Mo.; Frank Beresford, Cincinnati, Ohio; Edwin Mitchell, Norfolk, Va.; George Richard Sikes, Philadelphia, Pa.; George Oliver Tenney, Decatur, Ala.; Yoshichika Wada, Orrick, Mo.

The death on August 19th, 1887, of Mr. Albert J. Stahlberg, Jun. Am. Soc. C. E., was announced; also the death on July 14th, 1887, of Frederick Krupp, F. Am. Soc. C. E.

A set of lithographs of bridges erected in 1840 on the line of the Moscow and St. Petersburg Railway in Russia, was presented by Mr. Frederic C. Weir, M. Am. Soc. C. E.

Discussions on the subject of Inspection and Maintenance of Railway Structures, by Messrs. W. S. Lincoln and Robert A. Shailer, Members Am. Soc. C. E., were presented and the subject further discussed.

SEPTEMBER 21ST, 1887.—The Society met at 20 o'clock. Past Vice-President W. H. Paine in the Chair; John Bogart, Secretary. A discussion on Excessive Rainfalls, by Samuel Whinery, M. Am. Soc. C. E., was read and discussed by Messrs. Collingwood and Flagg.

A discussion on the Kentucky and Indiana Bridge, by J. W. Schaub, M. Am. Soc. C. E., was read and the subject discussed by Messrs. Cooper and Emery.

#### OF THE BOARD OF DIRECTION.

JULY 13TH, 1887.—A circular embodying the resolutions adopted at the informal meeting at Hotel Kaaterskill on July 4th, as to subscriptions to the Building Fund, was considered and its issue ordered. Applications were considered. Appropriations were made.

JULY 26TH, 1887.—Applications were considered. The resolution in reference to the appointment of a Committee on Technical Education and Professional Training (see Proceedings for July, page 94) was considered.

AUGUST 3D, 1887.—The subject of enlargement of Society House accommodations was discussed. Messrs. Thomas C. Clarke, Don J. Whittemore and Joseph M. Wilson were appointed a committee to solicit from among persons connected with engineering interests funds to procure a larger building for the Society. This Committee was requested to report on October 1st, 1887. The following Members were appointed a Board of Censors to award the Norman medal: Messrs. L. L. Buck, E. S. Philbrick and Thomas J. Whitman. The following Members were appointed to be, with the Secretary, the Committee to award the Rowland prize: Messrs. E. Sherman Gould and G. Lindenthal. The resolution in reference to a Committee on Technical Education and Professional Training was considered.

AUGUST 31ST, 1887.—Applications were considered and general business transacted.

SEPTEMBER 28TH, 1887.—Applications were considered. Messrs. Croes and Schneider were appointed a sub-committee to consider the resolution as to the appointment of a Committee on Technical Education and Professional Training, and report to the Board.

## THE NORMAN MEDAL.

### CODE OF RULES FOR ITS AWARD.

I.—Competition for the Norman Medal of the American Society of Civil Engineers shall be restricted to Members of the Society.

II.—There shall be one gold medal, and only one, struck for each and every fiscal year of the Society, and awarded as hereinafter provided. The dies therefor shall be with the Superintendent of the United States Mint at Philadelphia, in trust exclusively for the above purpose. Such medal shall be of a cost equal to the annual interest received upon \$1 000 of the Consolidated Stock of the City of New York, Certificate No. 179, of the additional new Croton Aqueduct Stock of the City of New York, authorized by an Act of the Legislature of the State of New York, Chap. 230, passed April 15th, 1870, dated November 17th, 1873, now held in trust by the Treasurer of this Society, and so held solely for this purpose, and shall be executed upon his order.

III.—All original papers presented to the Society by Members of any class, during the year for which the medal is awarded, shall be open to the award, provided that such papers shall not have been previously contributed in whole or in part to any other association, nor have appeared in print prior to their publication by the Society, nor have been presented to the Society in any previous year.

IV.—The Board of Censors to award the medal shall consist of three Members of the Society, to be designated by the Board of Direction. The Secretary of the Society shall act as Secretary to the Board of Censors.

V.—The medal shall be awarded to such paper as the said Board shall judge to be worthy of special commendation for its merits as a contribution to engineering science, not merely relatively as compared with others presented during the same year, but as exhibiting the science, talent or industry displayed in the consideration of the subject treated of, and for the good which may be expected to result from the discussion and the inquiry.

VI.—In case no paper presented during the year shall be deemed of sufficient value to receive an award, the amount of the interest of the fund for that year shall be expended by the Board of Direction in the purchase of books, to be offered as a premium for the second best paper in the next year in which more than one paper of sufficient value may be presented.

VII.—The medal year shall terminate on the first day of August, and the award shall be announced at the annual meeting.

VIII.—The Treasurer of this Society shall cause the medal to be prepared and delivered to, or deposited to the order of, the successful competitor, within two months after the annual meeting at which the same shall have been awarded.

## THE ROWLAND PRIZE.

### CODE OF RULES FOR ITS AWARD.

Not more than one prize shall be awarded each year for papers presented during the year. The year shall terminate on the first day of August, and the award shall be announced at the annual meeting in January.

The prize shall consist of fifty dollars in cash.

The award shall be made by a committee consisting of the Secretary and two Members of the Society, to be appointed by the Board of Direction.

The prize shall be awarded to such paper as the committee deem most worthy of such recognition, the preference being given to papers describing in detail accomplished works of construction, their cost and manner of execution, and the errors in design and execution.

### LIST OF MEMBERS.

#### A D D I T I O N S .

MEMBERS.	Date of Election.
ALDEN, JOHN FERRIS .....	Rochester Bridge and Iron Works, Rochester, N. Y. .... July 6, 1887.
ALLEN, CALVIN HARLOW .....	First Vice-President Buffalo, New York and Philadelphia R. R., 15 Broad street, New York City ..... Sept. 7, 1887.
ASHMEAD, FRANK MILLIGAN .....	Resident Engineer Allegheny Valley R. R., Pittsburgh, Pa. .... July 6, 1887.
BEMENT, ROBT. BUNKER COLEMAN.	Cor. Fourth and Waconta streets, St. Paul, Minn. .... Sept. 7, 1887.
BREITHAUP, WILLIAM HENRY ....	(Elected Junior, June 4, 1884), Room 33, Underwriters' Exchange, Kansas City, Mo. .... July 6, 1887.
BRENDLINGER, PETER FRANKLIN.	Engineer, Pennsylvania Schuylkill Valley R. R., Pottsville, Pa. .... Sept. 7, 1887.
BROWN, ALBA FISK .....	General Manager Keystone Bridge Co., Pittsburgh, Pa. .... Sept. 7, 1887.
DEVIN, GEORGE .....	(Care Theodore Cooper), 35 Broadway, New York City. .... Sept. 7, 1887.



DOUGLAS, HENRY THOMPSON.....	Chief Engineer Baltimore and Ohio R. R., Baltimore, Md.	July 6, 1887.
FARNHAM, ROSCOE EDWIN .....	234 La Salle street, Room 65, Chicago, Ill.....	Sept. 7, 1887.
GRAHAM, CHARLES HALLET.....	445 East 117th street, New York City .....	Sept. 7, 1887.
HENNY, DAVID CHRISTIAAN .....	(Care A. H. Howland), Equitable Building, Boston, Mass.....	Sept. 7, 1887.
HOWE, EDWARD WILLARD.....	City Engineer's office, Boston, Mass .....	Sept. 7, 1887.
JENKINS, WILLIAM DUNBAR.. . . .	Engineer in charge Chicago, Milwaukee and St. Paul Railway extension, 4 Hall Building, Kansas City, Mo .....	Sept. 7, 1887.
JOHNSTON, HORACE GREELEY .....	City Engineer, Salina, Kansas..	Sept. 7, 1887.
KIRTLAND, ALFRED POTTER.....	Superintendent Western Pennsylvania Division, Pennsylvania R. R., Blairsville, Pa. . .	Sept. 7, 1887.
LUTZ, ULYSSES STANISLAUS.....	Principal Assistant Engineer Bloomsburg and Sullivan R. R., Bloomsburg, Pa.....	July 6, 1887.
SHANLY, JAMES MOORE.....	Chief Engineer Beauharnois Junction Railway, Beauharnois, Canada.....	July 6, 1887.
SONNE, OTTO FREDERIK.....	Bridge Engineer Denver and Santa Fé R. R., Colorado Springs, Colo.....	Sept. 7, 1887.
STARLING, WILLIAM.....	Chief Engineer Mississippi Levee Commission, Greenville, Miss.	Sept. 7, 1887.
TOMLINSON, ALFRED THOMAS.....	Engineer Department Denver and Rio Grande R. R., Pueblo, Colo .....	Sept. 7, 1887.

JUNIORS.

BAIER, JULIUS.....	2606 N. Market street, St. Louis, Mo.....	Sept. 7, 1887
BELL, GILBERT JAMES .....	Assistant Engineer Sibley Bridge, Orrick, Mo.....	Sept. 7, 1887.
BERESFORD, FRANK.....	Engineer's office, Cincinnati, Hamilton and Dayton R. R., Cincinnati, Ohio.....	Sept. 7, 1887.
FARLEY, GEORGE MCGREW.....	Engineer Maintenance of Way New York and New England R. R., Hartford, Conn.....	April 6, 1887.
MITCHELL, EDWIN.....	City Engineer's office, Norfolk, Va.....	Sept. 7, 1887.
SIKES, GEORGE RICHARDS .....	423 Walnut street, Philadelphia, Pa.....	Sept. 7, 1887.

TENNEY, GEORGE OLIVER.....	Decatur Land Improvement and Furnace Co., Decatur, Ala....	Sept. 7, 1887.
WHEATLEY, JOSEPH YENDES .....	Assistant Engineer New York Central and Hudson River R. R., Room 21, Grand Central Station, New York City.....	June 1, 1887.

## CHANGES AND CORRECTIONS.

## MEMBERS.

ALLEN, C. FRANK.....	Massachusetts Institute of Technology, Bos- ton, Mass.	
APPLETON, E. C.....	Resident Engineer Chicago, Kansas and Nebraska R'y, Belleville, Kan.	
ATWOOD, WILLIAM H.....	617 East Second street, Jamestown, N. Y.	
BAKER, WILLIAM H.....	East Las Vegas, N. M.	
BLUNDEN, HENRY D.....	(Care Union Bridge Co.), Athens, Pa.	
BRINCKERHOFF, A. G.....	(Care Johnson & Morris), 114 Leonard street, New York City.	
BRINCKERHOFF, HENRY W.....	84 Fulton street, New York City.	
BRUEN, FRANK.....	Box 253, New Haven, Conn.	
BUTLER, M. J.....	(Care B. S. Cruker, Engineer Bridge and Water Service Atchison, Topeka and Santa Fé R. R.), Topeka, Kan.	
CARTWRIGHT, ROBERT.....	1 Hawthorn street, Rochester, N. Y.	
CLEMENT, FRANK H.....	124 West Forty-eighth st., New York City.	
CONNOR, ADDISON.....	Assistant Engineer Cairo Bridge, Cairo, Ill.	
CORNELL, O. H. P.....	53 Broadway, Room 25, New York City.	
DAGRON, JAMES G.....	Manager Bridge and Construction Depart- ment, Pencoyd Iron-works, Pencoyd, Pa.	
DAVIS, JOSEPH P.....	(Care Metropolitan Telegraph and Telephone Co.), 18 Cortlandt st., New York City.	
DOANE, WALTER A.....	(Care Oregon Pacific R. R.), Corvallis, Oregon.	
EATON, FRED.....	City Engineer, Los Angeles, Cal.	
ENGLE, ROBERT L.....	Chief Engineer Illinois Valley and Northern R. R., La Salle, Ill.	
FLAGG, J. FOSTER.....	16 Lafayette ave., Brooklyn, N. Y.	
FULLER, FRANKLIN I.....	Smith & Watson Iron-works, Front and Harrison sts., Portland, Oregon.	
GIELOW, HENRY J.....	113 Hudson st., Jersey City, N. J.	
GOODRICH, WILBUR F.....	Leominster, Mass.	
GREENE, B. D.....	New York Hotel, New York City.	
HUSON, H. S.....	Tacoma, Wash.	
KINNEY, EDWARD C.....	Assistant to Chief Engineer Union Pacific R'y, Denver, Colo.	

KITTREDGE, GEORGE W..	Engineer Maintenance of Way Jeffersonville, Madison and Indianapolis R. R. (Penna. Co., Lessee), Fourteenth and Main sts., Louisville, Ky.
LAFON, THOMAS.....	1109 Broadway, Kansas City, Mo.
MICHAELIS, O. E.....	Capt. Ordnance Corps U. S. A., Kennebec Arsenal, Augusta, Me.
MILIER, SILVANUS, JR.....	Guatemala City, Guatemala.
MORISON, GEORGE S.....	205 La Salle st., Chicago, Ill.
MORRIS, MARSHALL.....	P. O. Box 127, Lynchburg, Va.
NOBLE, ALFRED.....	Cairo, Ill.
PHILBRICK, P. H.....	Lake Charles, La.
POU, ARTHUR.....	Chief Engineer Alabama Midland R'y, Talbotton, Ga.
PURDON, CHARLES D . . . . .	Texarkana, Texas.
RAYMOND, CHARLES WARD . . . . .	39 Dearborn st., Chicago, Ill.
RICE, GEORGE S . . . . .	Deputy Chief Enginee Aqueduct Commission, Room 215 Stewart Building, New York City.
SAWYER, C. H . . . . .	Scottsville, Kan.
SCHAUB, JULIUS W. . . . .	Windsor Hotel, Montreal, Canada.
SEARS, CLINTON B.....	Capt. Corps of Engineers U. S. A., St. Paul, Minn.
SKINNER, FRANK W.....	Brownville, Jefferson County, N. Y.
SMITH, D. LOWBER.....	Deputy Commissioner Department Public Works, 70 West Eighty-third st., New York City.
SMITH, W. HARRISON.....	Engineer Carnegie Brothers & Co. (Ltl.), 48 Fifth ave., Pittsburgh, Pa.
TEMPLE, ROBERT H.....	Chief Engineer Tennessee Midland R'y, Cotton Exchange Building, Memphis, Tenn.
THACKRAY, GEORGE E.....	Assistant Superintendent Steel Department Springfield Iron Co., Springfield, Ill.
WAGNER, SAMUEL TOBIAS . . . . .	Superintendent of Shops Phoenix Iron Co., Phoenixville, Pa.
WETHERILL, W. C.....	(King & Wetherill), Savannah, Mo.
WHINERY, SAMUEL . . . . .	Somerset, Ky.
WHITFORD, O. F.....	2½ Russell st., Syracuse, N. Y.

JUNIORS.

BOGGS, EDWARD M.....	San Bernardino, Cal.
BOOKER, B. F . . . . .	Assistant Chief Engineer Chicago, Santa Fé and California R'y, 1214 Main st., Kansas City, Mo.
BUTTS, E. P.....	Assistant Engineer Willamette Bridge, Portland, Oregon.

CHAPIN, L. E.....	Produce Exchange, Rooms 47 and 48, Toledo, Ohio.
DONOVAN, JOHN J.....	Engineer in charge Helena and Northern R. R., Helena, Mon.
DURYEY, EDWIN, Jr.....	Engineer's Office, Omaha Bridge (Care Union Pacific R'y), Omaha, Neb.
EDES, WILLIAM C.....	Assistant Engineer Southern Pacific Co., Fourth and Townsend sts., Room 79, San Francisco, Cal.
GOLDSMITH, N. O.....	Ortiz Building, Cincinnati, Ohio.
GOSLING, EDGAR B.....	Assistant Engineer Department of Docks, New York City.
LELAND, GEORGE H.....	74 Westminster st., Providence, R. I.
MARVIN, C. E.....	Assistant Engineer South and North Alabama Div. Louisville and Nashville R. R., Birmingham, Ala.
MOSSCROP, ALFRED M.....	Rochester Bridge Co., Rochester, N. Y.
NOYES, ELLIS B.....	Assistant Engineer in charge New York State Canals, Syracuse, N. Y.
PARSONS, W. BARCLAY, Jr.....	35 Broadway, New York City.
SEAMAN, HENRY B.....	435 Chestnut st., Philadelphia, Pa.
TUTTLE, ARTHUR S.....	Assistant Engineer Department City Works, Municipal Building, Brooklyn, N. Y.
WEBSTER, ALBERT L.....	107 Drexel Building, cor. Wall and Broad sts., New York City.
WEISKOPF, SAMUEL C.....	Singer Building, Room 33, Pittsburgh, Pa.
YOUNG, HERBERT A.....	Revere, Mass.

## DEATHS.

KRUPP, FREDERICK.....	Elected Fellow June 14th, 1870; died July 14th, 1887.
MITCHELL, ALEXANDER.....	Elected Fellow June 13th, 1883; died April 19th, 1887.
STAHLBERG, ALBERT J.....	Elected Junior March 4th, 1874; died August 19th, 1887.

# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII.—October, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

OCTOBER 5TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the Chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates were declared elected. As Members: Henry St. Leger Coppée, Vicksburg, Miss.; Henry Clay Derrick, Halifax C. H., Va.; Joseph Norton Greene, Willimantic, Conn.; Edward Buckingham Guthrie (elected Associate September 3d, 1884), Buffalo, N. Y.; Charles Edward Hewitt, Trenton, N. J.; Wynkoop Kiersted, Falls City, Neb.; James Imbrie Miller, Tarrytown, N. Y.; Palmer Chamberlaine Ricketts (elected Associate February 4th, 1886), Troy, N. Y.; Granville Wheaton Shaw, Louisville, Ky. As Associate: Gratz Mordecai, New York City.

Messrs. Joseph P. Davis, William H. Paine and A. M. Wellington were appointed a Committee to draft an amendment to the Constitution in reference to methods of election to membership.

The majority of the Committee appointed under the resolutions adopted at the meeting of the Society, July 6th (see Proceedings, pp. 93 and 94), made the following report:

*President and Members of American Society of Civil Engineers:*

Your Committee appointed under a resolution adopted at the meeting of the Society held at Hotel Kaaterskill, July 6th, 1887, "To consider and report at the meeting on the first Wednesday of October, 1887, the advisability of adding a new grade of membership to be called 'Students,' and what alterations of the Constitution and By-Laws will



be required to establish such a grade," respectfully reports: That we have prepared and submit herewith amendments to Articles XVI, XVII, XVIII, of the Constitution, and a resolution fixing the dues to be paid by those who enter the proposed grade.

In considering the advisability of creating this new grade of membership, we have taken into full account the only objection that has been raised to such action; that it would lower the standard of the Society. If there be danger of such result, then your Committee would certainly report that the proposed action is not advisable. If membership of the Society is to remain as now established, then to add a lower grade would in a certain sense lower the average of the Society, and so afford some ground for the objection. If, on the other hand, the creation of a new grade is made the occasion of an advance in the standard of qualification for the higher grades, then the spirit of the objection is an argument for the proposed action. Another consideration influences your Committee, which is, that we find scant room for a grade of students below the requirements for the present Class of Junior. We therefore say, decidedly, that if the Society is unwilling to raise the standard of qualification required for membership in grades now established, then it is inexpedient and not advisable to create the proposed grade of students.

But if the Society is ready to raise the standard for all grades, then we say the creation of the proposed grade of students is expedient and advisable.

To test the disposition of the Society, and with confidence that it is ready for a step in advance, we report in favor of the adoption of the accompanying amendments and resolution.

ROBERT E. McMATH, *Chairman*.

ROBERT H. THURSTON,

W. H. PAINE,

ROBERT MOORE.

October 5th, 1887.

CONSTITUTION. *Article XVI.* The active members of the Society shall be divided into three classes, to be styled respectively Members, Associate Members and Associates; and each person, when duly elected and qualified, shall receive a certificate of Membership indicative of the class to which he belongs.

Associate Members shall have all the rights and privileges of Members excepting the right to hold office or to vote upon admission to membership. Associates shall have all the rights and privileges of Members excepting the right to hold office or to vote.

There shall also be a preparatory grade, to be designated Students of the Society, who shall have the right to attend all meetings not strictly devoted to business and to use the library and rooms of the Society under such regulations as the Board of Direction may adopt. They shall have by right the Transactions of the Society, and the privilege of presenting papers and written discussions.

Members of the Class previously styled Juniors shall, after March 7th, 1888, be classed as Associate Members.

*Article XVII.* A Member shall be a civil, military, mining or mechanical engineer, not less than thirty years of age, who has been in active practice as such for at least ten years, or has graduated at a school of engineering after a full course of study and been in practice seven years, and who continues in actual practice at the time of application for membership, and who has had responsible charge of work as chief, resident, or superintending engineer for at least two years, not as a skillful workman merely, but as one qualified to design as well as to direct engineering works.

An Associate Member shall be one over twenty-four years, who has had actual practice in some of the branches of civil, military, mining or mechanical engineering for at least five years, or if a graduate of a school of Engineering after a full course of study, who has practiced at least two years.

A Student shall be one not less than eighteen years of age, who is engaged in the study of engineering with the intent to become an engineer, and who has pursued that study at a technical school not less than one year, or who shall have been engaged in the study and practice of engineering under a competent engineer for not less than two years. A Student shall not remain in that grade for more than seven years; if not elected to a higher grade his connection with the Society shall terminate at the end of seven years.

*Article XVIII.* Insert after "Society," at the end of first line of printed copy, the words, "except to the grade of Student."

*Article XVIII.* Insert at end of first paragraph: "Nominations for Students shall be made out as for other grades, but the endorsement may be signed by a Member, Associate Member, or Associate, and but one such signature will be required. Such nominations shall follow the usual course of procedure for other grades except submission to a letter ballot; the Board of Direction shall elect or reject the applicant."

*Resolution fixing entrance fee and annual dues for Associate Members and Students:*

*Resolved,* In the event of the Society adopting amendments to the Constitution creating the grades of Associate Member and Students of the Society, that the entrance fee and annual dues of Associate Members shall be the same as established for Associates; for Students no entrance fee shall be required, and the annual dues shall be, for resident Students, ten dollars, and for non-resident Students, six dollars per annum.

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SUPPLEMENT to report of Committee stating reasons for the several changes and alterations in the Constitution that are proposed.

*Article XVI.—DESIGNATION OF CLASSES.*

It will be observed that the designation of the several classes is similar to that of the Institution of Civil Engineers, and, we may say, also to that adopted by the recently organized "Canadian Society of Civil Engineers." Uniformity of designation and in the standard of qualification for the several grades ought to be aimed at by the leading engineer societies; we think these designations appropriate.

## DEFINITION OF RIGHTS.

We think it well to give Associate Members superior rights to Associates, but materially less than Members. The rights of Students are secured.

Junior classes abolished; its members transferred to Associate Members.

This change will work no hardship, except to those who are enamored with the lower grade. The Society should put pressure on such to move along. Some of the recent admissions to the Junior class will get into Associate Membership under age, but this is no hardship to them.

*Article XVII.*—QUALIFICATIONS FOR MEMBERSHIP.

The age specified, thirty, is thought by your Committee to be a fair compromise between various suggestions, mostly higher.

The thought is, that admission to full Membership is a final endorsement by the Society of the man, and that his character should be fixed by experience under the test of actual life for several years. Membership will thus have a meaning and value, and its attainment will be an object to be sought. In the experience qualification the aim is to give decided preference to those who enter the profession with the advantage of a technical education. The extension of experience from seven to ten years, and responsible position from one to two years, is an intended advance in the required qualifications.

## QUALIFICATIONS OF ASSOCIATE MEMBERS.

This is a decided advance in age and experience over that required for the present class of Junior.

## QUALIFICATIONS OF ASSOCIATES.

Except the requirement of twenty-five years, the qualification for this class is unchanged.

## QUALIFICATIONS OF STUDENTS.

A decided advantage is allowed the student from a technical school, since there is now little excuse for any young man who would enter the profession without the advantage of a technical education. We have thought it well to fix a time, instead of age, limit to continue in this grade, otherwise those who graduate young and immature would have the advantage of older students. The grade of Associate Member should be fairly open to the student before his studentship terminates.

*Article XVIII.*—NOMINATION AND ELECTION OF STUDENTS.

But one indorser is required, and he may be of any grade higher than Student, because young men cannot be well known except by those with whom they have been associated in the capacity of pupil or subordinate.

Their election is left to the Board of Direction to emphasize the fact that Students are not Members of the Society, but are probationers, and subject to the Board of Direction for admonition and discipline.

Mr. FRED. BROOKS, member of the Committee, presented the following:

*To the American Society of Civil Engineers:*

The undersigned, as member of the Committee on a "Student" grade, begs leave to submit the following proposed amendments to the Constitution and By-Laws, with the accompanying expression of his dissent in a few particulars from the report of the majority of the committee.

## PROPOSED AMENDMENTS.

CONSTITUTION. Article XVI. Amend so that the last sentence shall read:

"Juniors shall have the right to use the rooms and library of the Society; to attend all meetings not strictly devoted to business; to take part in all professional discussions, and to receive all the professional publications of the Society."

Article XVII. As to qualifications of youngest grade, insert:

"Every candidate for election as Junior shall be more than eighteen and less than twenty-four years of age, and shall have been engaged in the study or practice of engineering not less than two years with the intention of becoming an engineer. If elected subsequently to 7th March, 1888, a Junior attaining the age of 27 years shall thereby cease to be connected with the Society; and if elected subsequently to 7th March, 1888, a Junior, when six years have elapsed from the date of his election, shall thereby cease to be connected with the Society."

Article XVIII. Insert at the end of the first line:

"except for the grade of Junior."

Insert at end of first sentence:

"For the grade of Junior such an indorsement by one person connected with the Society in any grade except Junior is required."

Insert at the end of the second sentence:

"A candidate for Junior must state that he intends to practice as an engineer."

Strike out last clause of the article, and substitute:

"When the transfer is made, he shall be required to pay the entrance fee of the grade which he is entering less the amount of entrance fee which he has previously paid."

Article XIX. In first line, after the word "class," insert:

"excepting those of Honorary Members, Fellows and Juniors."

At end add:

"The election of Juniors shall be by unanimous vote of the Board of Direction."

Article XXVIII. In the second line, after the word "Society," insert "excepting a Junior elected subsequently to 7th March, 1888."

At end add:

"A Junior elected subsequently to 7th March, 1888, may be peremptorily expelled by a majority vote of the Board of Direction at any time."

By-Laws. Section 19. Insert at end of first sentence: "Notices of Junior candidacy shall also be sent to all Juniors."

In 6th line strike out the word "Junior."



## REMARKS.

The resolution under which the Committee was appointed was essentially the expression of a desire to have connected with the Society younger men than at present and more young men than at present; and is of very similar purport to the circular urging an increase in the number of Juniors which the Board of Direction issued December 2d, 1885, in pursuance of a resolution of the Society adopted November 4th, 1885. It is proposed to allow young men to join the Society who have less experience than would qualify them for the present grade of Junior, without the recommendation from personal knowledge of five full Members as now required for becoming a Junior, and with the payment of less than the present Juniors; but the younger portion of the present Juniors might very simply form the nucleus of the youngest grade proposed, with proper provisions temporarily discriminating between young men elected before and after the proposed amendment of the Constitution, to avoid injustice. The name of "Junior" can be made available for designating the youngest grade very appropriately. The name of "Student," which has been suggested for that purpose, is evidently borrowed from the Institution of Civil Engineers in Great Britain, in which country there is an established practice of pupillage for young men under-engineers after leaving their technical schools; but in the United States the name of "Student" is not naturally applied to the incipient engineer, and would not be likely to attract him, except while he is in school. Students in technical schools now enjoy the privilege of consulting the Transactions of the Society, which are sent to the schools; and but few such students would, in the opinion of the undersigned, be likely to attach themselves to the Society before graduating.

It is often difficult for a very young man to find five members of the Society who know him; and it is proposed to avoid such a difficulty by requiring him to have only one indorser who would naturally be some one under whom he had been engaged in work or study, and who might be an Associate. It is also proposed to require no initiation fee of the Junior. It being thus made very easy for him to get into the Society, it should be correspondingly easy for the Society to put him out without ceremony; but when he comes to enter a higher grade, after his character has had time to mature and become known, he is required to get five Members to indorse him, to pay an initiation fee, and to submit his name to a ballot of the Members of the Society. After complying with all requirements of the higher grade, he cannot be expelled from the Society without the right to be heard in his own defense and appeal to a letter ballot.

If the annual assessment for the non-residents of the youngest grade should be made as great as the actual cost to the Members of publishing the Transactions and Proceedings (which is nearly \$10 per member per annum) it is thought that but few would join the grade. As the Trans-



actions and Proceedings have to be published in any case, the Society can, however, afford to strike off extra copies and sell them for but little more than the cost of paper and press-work. It is therefore feasible to fix the annual assessment of the proposed youngest grade at an amount \$4 or \$5 below that of the present Associates and Juniors.

Article XXII of the Constitution provides that no alteration in the amount of fees or assessments shall apply to the fiscal year in which it is made, but that it shall take effect on and after the first day in January next succeeding the day of the date of said alteration. Therefore it is proposed to carry into effect no change in Junior fees during the year 1888, no matter what change in the qualifications for Junior may be made March 7th, 1888. The inequality thus arising between Juniors elected before and after January 1st, 1889, will, however, be partially compensated for by making proper allowance when they come to pay their initiation fees for entering a higher grade. The difference of \$4 between the proposed annual assessments of resident and non-resident Juniors after January 1st, 1889, represents the privileges of using the rooms and library and attending meetings; and the amount of difference is nearly the same as in the case of the present Juniors and Associates. It has been alleged in public discussion of the proposed admission of young men to the Society, that they could not with propriety be admitted to the presence of the punch-bowl after the meetings. That the prominence given to intoxicating beverages at its meetings has already hurt the Society in the opinion of valued members is unfortunately true; but a constitutional amendment purporting to be promotive of the growth of the Society is what is now under consideration; objections to it may exist not known to the undersigned, but seriously to allege as an objection that the meetings of the Society must be unfit for the presence of young men would not be simply scandalous, it would be ridiculous.

To make it impossible for a Junior to become a Member directly without passing through an intermediate grade (as well as for other reasons), it would be well to fix the minimum age for admission as Members at as much as twenty-eight years.

Amendments might also be made, if it were thought worth while, affecting By-Laws 11, 14, 15 and 23, so that Juniors elected subsequently to March 7th, 1888, should not be qualified to serve on special committees upon engineering subjects, or entitled to introduce visitors to the rooms, recommend books for the library, examine the records, or wear the Society's five-dollar badge.

Respectfully,

FRED. BROOKS.

The following resolution was adopted:

*Resolved*, That the report of the majority of the Committee be accepted, printed for distribution to the Society, and that the Committee

be continued, with request to report again at the meeting of the Society on the first Wednesday in November.

A discussion on Excessive Rainfalls, by William Rumble, M. Am. Soc. C. E., was read.

OCTOBER 19TH, 1887.—The Society met at 20 o'clock. Past Vice-President William H. Paine in the Chair; John Bogart, Secretary. A note on Brick-making in Sinaloa, Mexico, by Senor Don Juan Sosa y Avela, was read and discussed.

The results of some experiments as to the influence of fineness of sand upon cement mortars, by E. Kuichling, M. Am. Soc. C. E., was read.

Notes upon peculiar behavior of brands of natural cement made in the neighborhood of Syracuse, N. Y., by Ellis B. Noyes, Jun. Am. Soc. C. E., were presented, and the subject discussed by Messrs. Parsons, Tomkins, Emery, W. H. Paine, Bogart and Asserson.

#### OF THE BOARD OF DIRECTION.

OCTOBER 26TH, 1887.—Applications were considered.

Mr. Hamilton, on behalf of Committee appointed in reference to the opening of Elm street, in New York City, reported that the Committee had presented to the New York Board of Street Openings a report, a copy of which would be furnished for the archives of the Society.

The Sub-Committee on Technical Education and Professional Training reported progress. Appropriations were made.

## MEMOIRS OF DECEASED MEMBERS.

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SULLIVAN HASLETT, M. Am. Soc. C. E.

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DIED JANUARY 4th, 1887.

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Sullivan Haslett was born in Brooklyn, N. Y., August 28th, 1843; his father was Dr. John Haslett, surgeon United States Navy, and his mother Teresa Sullivan, of Brooklyn. He commenced his education under Benjamin W. Dwight and Messrs. Clark & Brownell, both Brooklyn schools.

He entered Harvard University with the class of '64, but left at the close of his Sophomore year to join his family in Europe, where he resided and studied three years. After his return he entered the New York University, received the degree C. E. in 1868, and commenced at once as Chain-man on the surveys of the West Shore and Hudson River Railroad; next year on the New Jersey Western Railroad; and then on the New Haven, Middletown and Willimantic Railroad. Assistant Engineer from 1869 to 1871, and Division Engineer in charge of the Lyman and Rapallo Viaducts from 1871 to 1873. In 1873 he was Assistant Engineer, under James P. Kirkwood, M. Am. Soc. C. E., on a survey for the water supply of Hackensack, N. J. In 1874-75 President and Engineer for the contractors of Anacostia Highway Bridge, Washington, D. C. He was for a time on the construction of Camp's Dry Dock and the Waban Bridge, Boston, Water-works. From 1877-79 Superintending Engineer for Clarke, Reeves & Co. on the construction of the Sixth and Second Avenue Elevated Railroads, New York City. He also made surveys for the Blackwell's Island Bridge and the Walnut Street Bridge, Philadelphia, for these gentlemen. In 1881, Chief Engineer of the Toledo, Cincinnati and St. Louis Railroad.

In 1882, while making a survey for the water supply for a gold mine near Salisbury, N. C., he met with a very serious accident by being thrown from a wagon, from the results of which he thought he never completely recovered, and to which he ascribed something of his last illness.

In 1868 he was Consulting and then Constructing Engineer on the Chatanqua Lake Railroad. From September, 1880, till his death, he was associated with John G. Van Horne, M. Am. Soc. C. E., in an office in New York City, for surveying and general engineering, and there gave many plans for bridges and elevated railroads; and as a member of the firm of C. O. Richards & Co., erected many large bridges and had, at the time of his death, a large contract in Arkansas on a branch of the Iron Mountain Railroad.

He became a member of the American Society of Civil Engineers June 4th, 1879, and died January 4th, 1887, unmarried.

In his profession he was well educated, and from a large experience, although modest, capable and confident. His professional and moral standing was high, and as a Member of our Society he sought to maintain such a standard in the association. He was a man of extraordinary truthfulness of mind and character, which showed itself not only in the extreme accuracy of his professional work, but in all his habits, and conversation and dealings with others, so that he always inspired confidence in those who met him, which was increased the longer they knew him. He was a modest, courteous, upright and honorable gentleman, one whom it was good to know.

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Committee to prepare memoir: Messrs. William E. Worthen, President; and Thomas C. Clarke and Charles D. Ward, Members Am. Soc. C. E.

# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII, November, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

NOVEMBER 2D, 1887.—The Society met at 20 o'clock. President William E. Worthen in the Chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates were declared elected. As Members: George Earl Church, London, England; Henry Stevens Haines, Savannah, Ga.; David Carlisle Humphreys, St. Louis, Mo.; William Datus Kelly, Jr., Tarrytown, N. Y.; Rowland Robinson Min-turn, Milwaukee, Wis.; James Moylan, New York City; Cornelius Palmer, Escanaba, Mich.; William Barclay Parsons, Jr. (elected Junior June 7th, 1882), New York City; Edward Fesser Playle, Morris Dock, N. Y.; Albert Fowler Robinson, St. Paul, Minn.; Orlando Belina Wheeler, St. Louis, Mo. As Associate: Arthur James Moxham, Johnstown, Pa. As Juniors: Archie McLean Hawks, St. Louis, Mo.; Downing Vaux, New York City.

The death, on October 14th, 1887, of Mr. Eugene F. Falconnet, M. Am. Soc. C. E., was announced; also the death, on October 19th, 1887, of Mr. Frederic W. Vaughan, M. Am. Soc. C. E., and Past Director of the Society.

Nominations made by the Nominating Committee for officers for the ensuing year were read.

The Committee appointed under the resolution adopted at the meeting of the Society July 6th, in reference to establishing a grade of Students of the Society submitted its final report as follows:

*To the President and Members of the American Society of Civil Engineers:*

Your Committee, appointed under a resolution adopted July 6th, and continued by resolution adopted October 5th, submits as its final



report the following proposed amendments to the Constitution and By-Laws of the Society:

1.—Amend Article XVI of the Constitution by substituting for the present Article the following:

CONSTITUTION. *Article XVI.*—The active members of the Society shall be divided into three classes, to be styled respectively Members, Associate Members and Associates; and each person, when duly elected and qualified, shall receive a certificate of Membership indicative of the class to which he belongs.

Associate Members shall have all the rights and privileges of Members, excepting the right to hold office or to vote upon admission to membership or changes in the Constitution and By-Laws of the Society. Associates shall have all the rights and privileges of Members excepting the right to hold office or to vote.

There shall also be a preparatory grade, to be designated Students of the Society, who shall have the right to receive the Transactions of the Society and to present papers and written discussions. They shall also have the right to use the library and rooms of the Society, and to attend its meetings subject to such regulations and restrictions as the Board of Direction may adopt.

Members of the class previously styled Juniors shall, after March 7th, 1888, be classed as Associate Members.

2.—Amend Article XVII of the Constitution by substituting for the present Article the following:

*Article XVII.*—A Member shall be a civil, military, mining or mechanical engineer, not less than thirty years of age, who has been in active practice as such for at least ten years, or has graduated at a school of engineering and been in practice seven years, and who has had responsible charge of work as chief, resident, or superintending engineer for at least two years, not as a skillful workman merely, but as one qualified to design as well as to direct engineering works.

An Associate Member shall be one not less than twenty-four years of age, who has had actual practice in some of the branches of civil, military, mining or mechanical engineering for at least five years, or has graduated at a school of engineering and been in practice two years, and who continues in actual practice at the time of his application for membership.

An Associate shall be one not less than twenty-five years of age, who is a manager of a railroad, canal or other public work; a geologist, chemist or mathematician; a proprietor or manager of a mine or metallurgical works; an architect or a manufacturer; or one who, from his scientific acquirements or practical experience, has attained eminence in his special pursuit, qualifying him to co-operate with engineers in the advancement of professional knowledge; but shall not himself be practicing as an engineer.

A Student shall be one not less than eighteen, nor more than twenty-seven years of age, who is engaged in the study of engineering with the intent to become an engineer and who has pursued that study at a technical school not less than one year, or who shall have been engaged in the study and practice of engineering under a competent engineer for not less than two years. A Student shall not remain in that grade for more than seven years; if not elected to a higher grade his connection with the Society shall terminate at the end of seven years, or upon his attaining the age of twenty-seven years.

3.—Amend Article XVIII of the Constitution by substituting for the present Article the following:

*Article XVIII.*—Nominations and proposals for admission to the Society, except to the grade of Student, shall be indorsed by at least five members, who certify that they personally know the nominee or candidate, and that he is worthy of acceptance. The proposal for Member, Associate Member, or Associate, shall contain a statement, over the candidate's signature, of his age, residence, the nature and term of his professional service, and that he will conform to the requirements of membership, if elected. Fellows shall not be required to present themselves as candidates; those making the nomination shall state the ground therefor, and certify that the nominee will accept, if elected. Nominations for Students shall be made out as for other grades, but the indorsement may be signed by a Member, Associate Member, or Associate, and but one such signature will be required. Such nominations shall follow the usual course of procedure for other grades except submission to a letter-ballot; the Board of Direction shall elect or reject the applicant.

A proposal for transfer from one class to a higher shall be made by at least five Members, and shall state the age of the candidate, and the nature and term of his professional service since his admission to the Society. Such statement shall show a degree of qualification sufficient to render the proposed eligible to election in the class to which transfer is asked. Upon the approval of the Board of Direction, the candidate shall be balloted for, as provided in the election of members; and when the transfer is made, he shall be required to pay as an additional entrance fee the amount of the difference between the entrance fees of the two classes.

4.—Amend Article XIX of the Constitution by adding a clause at the end thereof, making it read as follows:

*Article XIX.*—In elections for membership of either class, Members shall vote by letter, or by ballot in the usual way, and the result shall be announced at the next regular meeting held after twenty-five days have elapsed from the time of mailing the notification. Five or more ballots cast in the negative shall exclude. Members notified but not responding shall be classed as having voted in the affirmative. In case of the non-election of any person balloted for, no notice shall be taken thereof in the minutes.

In the election of Students by the Board of Direction, one negative vote shall exclude the applicant.

5.—Amend Article XXVIII of the Constitution by adding a clause at the end thereof making it read as follows:

*Article XXVIII.*—Upon the written request of ten or more Members, that for cause therein set forth, a person belonging to the Society be expelled, the Board of Direction shall consider the matter, and if there is sufficient reason, shall advise the accused that his resignation will be accepted. He may, upon demand, receive a copy of the charges against him, and present a written defense. Two months after such advice was given, the Board of Direction shall finally consider the case, and if resignation has not been tendered, or a satisfactory defense made, will then notify the Member that he will be expelled in one month, unless he elects to appeal from this decision. Appeals will be submitted to the Society by letter-ballot. In case no appeal be made, the Board of Di-

rection will expel the Member and notify him and the Society of the same, or of the action of the Society on appeal, and the above shall in any event be the only public announcement of the matter. A Student may be summarily expelled by a majority vote of the Board of Direction at any time.

Amend Section 19 of By-Laws, by inserting the words Associate Member and striking out the word Junior, making it read as follows:

*Section 19.*—A nomination or proposal shall be presented at the next regular meeting of the Board of Direction following its receipt; the Board of Direction shall thereupon send to all Members of the Society a notice that such person is a candidate for election. Not less than thirty days thereafter the Board shall consider the application, and if approved and the applicant (if for admission as Member, Associate Member, or Associate) classed with his consent, a day shall be fixed for the ballot to be canvassed, which shall be at a regular meeting of the Society, not less than twenty-five days thereafter.

The above amendments to the Constitution, numbered 1 to 5, are hereby proposed to the Society by those who sign this report under the provisions of Article XXXIII of the Constitution.

ROBERT E. McMATH.

ROBERT MOORE.

ROBERT H. THURSTON.

WILLIAM H. PAINE.

FRED. BROOKS.

The following proposed amendment to the Constitution was submitted in writing, signed by Messrs. Theodore Cooper, William R. Hutton, A. D. Foote, Pedro J. Sosa and Joseph P. Davis:

Amend Article XVIII of the Constitution by inserting after the word "*acceptance*," at the end of the first clause of the article, the following:

"But the proposals for admission to the Society, of engineers not resident in North America, and who may be so situated as not to be personally known to five members of the Society, may be indorsed for ballot by five members of the Board of Direction, who shall, for such purpose, secure evidence sufficient in their opinion to show that the candidate is worthy of acceptance."

The following proposed amendment to the Constitution was submitted in writing, signed by Messrs. J. James R. Croes, G. S. Greene, Jr., D. McN. Stauffer, O. F. Nichols, and Charles W. Hunt:

Amend Article XIX of the Constitution by substituting for the whole article the following:

"*Article XIX.*—Members shall be elected by the Board of Direction by an affirmative vote of two-thirds of the members thereof. In case of the non-election of any person balloted for, no notice shall be taken thereof in the minutes."

The following proposed amendment to the Constitution was submitted in writing, signed by Messrs. Theodore Cooper, F. A. Calkins, D. McN. Stauffer, L. L. Buck, and Joseph P. Davis:

Amend Article XIX of the Constitution by adding thereto the following:

“The Board of Direction, upon receipt of letters from not less than eight members in good standing, requesting a reconsideration of the proposal of any rejected candidate, and stating the reasons for the request, may, if it considers the reasons to be sufficient, order another ballot to be taken; whereupon the Secretary shall mail to each member whose address is known, a notice of the same, with a letter ballot in such form as shall be prescribed by the Board of Direction, and requesting the recipient to vote thereby, or in person, on the day appointed by the Board to canvass the ballot. The ballot shall be an open ballot, and five or more ballots cast in the negative shall exclude. The Board shall designate a regular meeting at which the ballot shall be canvassed, which meeting shall be not less than twenty-five days after the Secretary has issued the notice above mentioned.”

Mr. Joseph P. Davis, of the committee appointed October 5th, to draft an amendment to the Constitution in reference to methods of election to membership, reported that much work had been done upon the subject; that the amendments as to change of grade just offered made it difficult to frame other amendments which might not interfere with those already proposed; that the Committee had arrived at no conclusion.

Notice was given of the following intended resolution, under Article XXII of the Constitution:

*Resolved*, In the event of the Society adopting amendments to the Constitution creating the grades of Associate Member and Students of the Society, that the entrance fee and annual dues of Associate Members shall be the same as established for Associates; for Students no entrance fee shall be required, and the annual dues shall be, for resident Students, ten dollars, and for non-resident Students, six dollars per annum.

A paper on Replacing the Stone Towers of the Niagara Railway Suspension Bridge with Iron Towers, by L. L. Buck, M. Am. Soc. C. E., was read, and discussed by Messrs. Cooper, Worthen and Croes.

NOVEMBER 16TH, 1887.—The Society met at 20 o'clock, President William H. Worthen in the Chair; Theodore Cooper, Secretary *pro tem*. A paper on Experiments upon Z Iron Columns, by C. L. Strobel, M. Am. Soc. C. E., was read.

A paper on Test of a Wrought-Iron Double-track Floor Beam, by A. P. Boller, M. Am. Soc. C. E., was read and discussed by Messrs. Charles O. Brown, Lucius Lindenthal, Dagron, Cooper, Buchholz and Devin.

A chart of wire gauges was presented and explained by S. S. Wheeler, Jun. Am. Soc. C. E., and discussed by Mr. Metcalf.

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#### OF THE BOARD OF DIRECTION.

NOVEMBER 30TH, 1887.—Applications were considered. The report of the Nominating Committee was presented, and the action prescribed by the By-Laws was directed.



## MEMOIRS OF DECEASED MEMBERS.

JOHN GROSS BARNARD, Hon. M. Am. Soc. C. E.

DIED MAY 14th, 1882.

Major-General John Gross Barnard, Colonel of the Corps of Engineers, United States Army, Honorary Member of the Society, died at Detroit, Michigan, on the 14th May, 1882, after a protracted illness.

He became a member of this Society September 15th, 1869, and an Honorary Member by a vote of the Society, April 7th, 1873.

He was born in Sheffield, Mass., on the 15th of May, 1815, and was the son of Colonel Robert Foster Barnard, a distinguished lawyer of Berkshire County, Massachusetts. His mother was Augusta, daughter of Dr. Joshua Porter, a physician of Salisbury, Conn.

He entered the Military Academy at West Point, July 1st, 1829, and graduated July 1st, 1833.

General Barnard married, first, Jane Elizabeth, daughter of William Brand, of New Orleans. He had four children, viz.: Robert Foster, William Frederick, Augustus Porter and Robert Foster 2d, of whom only Augustus Porter survives. He married, second, Anna Eliza (Hall) Boyd, daughter of Major Henry Hall, of Harford County, Maryland, by whom he had John Hall, Jane Brown and Anna McHenry.

The following order from the Headquarters of the Corps of Engineers is an official statement of his services and a just memorial to his character:

HEADQUARTERS CORPS OF ENGINEERS,  
UNITED STATES ARMY,  
WASHINGTON, D. C., May 20th, 1882.

GENERAL ORDERS }  
No. 4. }

It has become the painful duty of the brigadier-general commanding to announce to the corps of engineers the death of a brother officer, Colonel John G. Barnard, brevet major general, United States Army (retired), who died at Detroit, Mich., on the 14th inst.

General Barnard was graduated from the military academy and promoted to the rank of brevet second lieutenant in the corps of engineers July 1st, 1833. He served as assistant to the Board of Engineers at Newport, R. I., 1833-34; assistant engineer in the construction of Fort Schuyler, 1834-35; on the fortifications of Pensacola Harbor, Fla., 1835; on the improvement of Pascagoula River, 1836; and of Mobile Harbor, Ala., 1837-39; as superintending engineer of the defenses at Governor's Island, New York Harbor, 1839-40; of the construction of Fort Livingston, Island of Grand Terre, La., and of Forts Jackson and St. Philip, La., 1840-46, 1847 and 1848-50.

In the war with Mexico, 1846-48, he superintended the construction



of the defenses of Tampico, and surveyed the battlefields about the City of Mexico.

He was chief engineer for the exploration and survey of the projected Tehuantepec Railroad, Mexico, 1850-51; superintending engineer of Delaware Breakwater, of harbor improvements east of Cape Malabar, Mass., and of defenses of Portland, Me., 1852-53; of construction of fortifications at the entrance of San Francisco Harbor, Cal., and lighthouse at Alcatraz Island, Cal., and member of the board of engineers for fortifications on the Pacific Coast, 1854.

He was on duty at the United States Military Academy, 1855-56, as instructor of practical military engineering, commandant of sappers, miners and pontoniers, and superintendent.

He was superintending engineer of defenses of New York Harbor, and of the improvement of the Hudson River and of New Jersey Harbors, 1856-57; of Forts Gaines and Morgan, Mobile Harbor, Ala., 1857-58; and of the construction of Forts Wadsworth and Tompkins, Staten Island, N. Y., and of the inner defenses of New York Harbor, 1858-59, 1860-61; and member of board of engineers for Atlantic coast defenses, 1857-61.

He served during the late civil war, 1861-66. He was chief engineer of the Department of Washington, 1861; and in the Manassas campaign of July, 1861, being present at the action of Blackburn's Ford and battle of Bull Run; chief engineer of the Army of the Potomac, and superintending the construction of the defenses of Washington, D. C., 1861-62.

In the Virginia Peninsula campaign, 1862, he was engaged in directing the siege works at Yorktown, and offensive and defensive works on the Chickahominy; reconnoitered and selected the position upon which was fought the battle of Gaines' Mill; reconnoitered the passages of the White Oak Swamp and the position of Malvern Hill for defense, and took part in the battle of Williamsburg, combat on Williamsburg Road, and battle of Malvern Hill.

He was chief engineer of the defenses of Washington, D. C., 1862-64; reconnoitering for and devising the defenses of Pittsburg, Pa., 1863; examining south shore of Lake Erie to devise measures to prevent raids from Canada, 1863; and member of the board of engineers to reorganize our system of sea-coast fortification, 1864.

He served as chief engineer "of the armies in the field," on the staff of Lieutenant-General Grant, general-in-chief of the armies of the United States, 1864-65, in the Richmond campaign, being engaged in the siege of Petersburg and operations before Richmond, and participated in various engagements before Petersburg; assault and capture of Fort Harrison; combat near Hatcher's Run; assault of Petersburg and its capture; and in the pursuit and at the surrender at Appomatox Court House of the army of Northern Virginia commanded by General Lee.

After the close of the war he was senior engineer of the defenses of New York Harbor, and in charge of the construction of the fortifications on Staten Island, N. Y., 1865-66; member of board to conduct experiments on the use of iron in permanent defenses, 1866-67, and member of the board of engineers for fortifications and harbor and river improvements from 1867 until his retirement from active service, January 2d, 1881.

He was a member of the lighthouse board from 1870 to 1879; member of the commission on behalf of the Tehuantepec Railway and Canal Company, to examine the principal waterways of Europe, 1871; and member of many special boards and commissions for the consideration

of a great variety of professional questions connected with the public interests committed to the corps of engineers.

General Barnard was promoted successively from the grade of lieutenant to that of colonel corps of engineers and brigadier-general United States Volunteers. He received the brevets of major, United States Army, "for meritorious conduct while serving in the enemy's country," in the war with Mexico, 1848; colonel, United States Army, "for gallant and meritorious services in the campaign of the Peninsula," 1862; major-general, United States Volunteers, "for meritorious and distinguished services during the rebellion," 1864; brigadier-general, United States Army, "for gallant and meritorious services in the campaign terminating with the surrender of the insurgent army under General R. E. Lee," 1865; and major-general, United States Army, "for gallant and meritorious services in the field during the rebellion," 1865.

He was a member and an original corporator of the National Academy of Sciences; a member of the American Institute of Architects, and an honorary member of the American Society of Civil Engineers. The degree of A. M. was conferred upon him by the University of Alabama in 1838, and of LL. D. by Yale College in 1864.

He was the author of various works, among which are "Dangers and Defenses of New York," 1859; "Notes on Sea Coast Defense," 1861, and (jointly with the late General Barry) of "Reports of the Engineer and Artillery Operations of the Army of the Potomac," 1863; also of "Report (jointly with General Wright and Colonel Michie) on the Fabrication of Iron for Defensive purposes," 1871-72; "Report on the Defenses of Washington," 1871; "Report on the North Sea Canal of Holland," 1872, and of other scientific and professional papers.

A service of nearly fifty years in the corps of engineers has been closed by the death of one of the most prominent of its members.

Of greatly varied intellectual capacity, of a very high order of scientific attainments, considerate and cautious, ripe in experience, sound in judgment, General Barnard has executed the important duties with which he has been charged during his long and useful life with conscientious care and regard for the public interests, and with an enthusiastic devotion to his profession. His corps, the army and the country are his debtors.

Modest and retiring in disposition, considerate and courteous, warm in his sympathies and affections, our deceased associate will be missed as few are missed, and his name, which will be held as one of the foremost names of the corps of engineers, will be cherished with peculiar love and affection by his brother officers.

As a testimonial of respect for the deceased, the officers of the corps will wear the usual badge of mourning for thirty days.

By command of Brigadier-General Wright:

GEORGE H. ELLIOT,  
Major of Engineers.

In 1852 he was a member of a board for carrying into effect a law of Congress "for opening a ship channel of sufficient capacity to accommodate the wants of commerce" at the mouth of the Mississippi.

He was an early and steady advocate for an open channel to the Gulf of Mexico. His paper, read before the Society in March, 1875, gives the history of the various attempts to deepen the channel, which were never undertaken with sufficient means to test thoroughly the plans, and thus

ended in failure. In this early conception and constant advocacy of the open channel question he gave evidence of that deep research and practical knowledge which were his distinguishing characteristics.

Although constantly engaged in the practical duties of his profession, he made large contributions on scientific and professional subjects. Among his contributions are the following: To Sullivan's Journal, Vol. XX, 1855—Demonstration of the Apparent Motion of the Plane of Oscillation of the Pendulum Due to the Earth's Rotation. Vol. XXIV, 1857—Self-sustaining Power of the Gyroscope Analytically Examined. Vol. XXV, 1858—On the Motion of the Gyroscope as Modified by the Rotary Forces of Friction and the Resistance of the Air, with a brief Analysis of the "Top." Vol. XXVII, 1859—The Dynamic Theory of the Tides. Vol. XXIX, 1860—On the Causes of the Deviation in Elongated Projectiles.

Papers read before the American Society of Civil Engineers:

Vol. I, 1872.—Experiments on the Front or Shield of the Experimental Casements at Fort Monroe.

Vol. III, 1874.—Resistance of Beams to Flexure.

Vol. IV, 1875.—The Delta of the Mississippi. Considered in Relation to an Open River Mouth.

Vol. VIII, 1879.—Lighthouse Engineering as Displayed at the Centennial Exhibition.

Vol. IX, 1880.—Remarks on the Cause of Fall of the Western Arched Approach to the South Street Bridge, Philadelphia.

Before the American Association:

Vol. XXII, 1873.—On the Relation of the Internal Fluidity to the Precession of the Equinoxes.

Contribution to the Smithsonian Institution:

Vol. XIX, 1874.—Problems of Rotary Motion Presented by the Gyroscope; the Precession of the Equinoxes and the Pendulum, 1871.

Vol. XXIII, No. 300.—On the Internal Structure of the Earth, Considered as Affecting the Phenomena of Precession and Nutation, with addenda.

Report on the "Dangers and Defences of New York," 1859. Report on "Operation of the Army of the Potomac," and "Defences of Washington." "Notes on Sea Coast Defences," 1862. "The Confederate States and Battle of Bull Run." "Operations of the Army of the Potomac," 1863.

General Barnard wrote on almost every question which was presented for discussion. Being for many years a member of U. S. Board of Engineers, the subject of fortifications was constantly before him, which he handled with earnestness and skill. He was a large and valuable contributor to Johnson's Encyclopedia.

That General Barnard's character as a military engineer, was duly

appreciated by the Government is evidenced by the important positions to which he was called, and by the brevets which were conferred on him.

In 1864, on the death of General Totten, he was nominated to the Senate for the position of Chief of Engineers of the Army, being then a Lieutenant Colonel in the corps. This he requested the President to recall and appoint his senior to the place. This was done. A self-sacrifice of rare occurrence.

His personal character was above reproach. Firm in purpose and in action; kind and considerate to his associates; always earnest in performing his duty to his country and to his God.

**BENJAMIN DIX FROST, M. Am. Soc. C. E.**

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DIED JULY 19TH, 1880.

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Benjamin Dix Frost was born in Wayland, Mass., in 1830, became a Member of this Society February 21st, 1872, and died in St. Louis, July 19th, 1880.

He graduated with honor at Rutgers College at the age of fifteen, and, after a year passed in post-graduate studies at Harvard University, at the age of sixteen he entered the office of Felton & Parker, Civil Engineers, who had their place of business on City Square, Charlestown, Mass. Under Felton & Parker he was engaged upon various surveys in New Hampshire and Massachusetts, and had charge of work upon the Fitchburg Railroad. After leaving their service he was employed under Benjamin H. Latrobe upon the Baltimore and Ohio Railroad, among other work having charge of the construction of the "Board Tree" Tunnel. Afterwards he was engaged upon the Western Maryland Railroad, the Alexandria, Loudon and Hampshire Railroad, the Sunbury and Erie Railroad, and the Atlantic and North Carolina Railroad. Also upon the Brooklyn Park, the Central Park of New York, the Washington Aqueduct, and the improvements in Boston Harbor. In May, 1868, he was appointed superintending engineer of the Hoosac Tunnel for the Commonwealth of Massachusetts. At that time the excavation of the tunnel was about one-sixth done. Under Mr. Frost as engineer this great work was prosecuted until its completion and opening for business, July 1st, 1876. He was then appointed consulting engineer for the Troy and Greenfield Railroad and Hoosac Tunnel, and so continued until December 31st, 1876, when he left the Commonwealth's service. After his retirement, being in bad health, he did not attempt any work of importance, and died three years and a half later.

As a student Mr. Frost was remarkably apt, and showed uncommon capacity for acquiring knowledge. As an engineer he was of untiring industry, devoted to the interests of his employers, willing and anxious to work day and night for their advantage. Under his administration and direction as chief engineer of the Hoosac Tunnel, results in underground surveying were brought about which were without precedent for accuracy, so far as is known to the writer of this sketch. The matter of directing the headings to a proper meeting was the principal and most difficult engineering question connected with the Hoosac Tunnel at that time, and the work was performed in a remarkably precise and successful manner. Its details were quite fully published in the public



documents of Massachusetts and elsewhere, and it is unnecessary to repeat them here.

Socially, Mr. Frost had many rare and amiable qualities, and the writer, who served six years under him as an assistant engineer, esteems it as a privilege here to pay a last tribute to his generous and upright character and his refined and kindly bearing, and to testify to the affectionate regard in which he was held by his subordinates and others who understood his temperament and motives.

# American Society of Civil Engineers.

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## PROCEEDINGS.

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Vol. XIII, December, 1887.

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### MINUTES OF MEETINGS.

(Abstract of such as may be of general interest to members.)

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#### OF THE SOCIETY.

DECEMBER 7TH, 1887.—The Society met at 20 o'clock. President William E. Worthen in the Chair; John Bogart, Secretary. Ballots were canvassed, and the following candidates were declared elected. As Members: Tucker Carrington Eggleston, Richmond, Va.; Charles Edward Newham, Vincennes, Ind.; Henry Bowman Seaman (elected Junior, June 2d, 1886), Philadelphia, Pa. As Juniors: William Pierson Field, Newark, N. J.; Robert Van Arsdale Norris, Wilkesbarre, Pa.

The following resolution, notice of which was given at the previous regular meeting, was offered and adopted:

*Resolved*, In event of the Society adopting amendments to the Constitution creating the grades of Associate Member and Students of the Society, that the entrance fee and annual dues of Associate Members, shall be the same as established for Associates; for Students no entrance fee shall be required, and the annual dues shall be, for resident Students, Ten Dollars, and for non-resident Students, Six Dollars per annum.

The final discussion On Steel: Its Properties, Its Use in Structures and Heavy Guns, by William Metcalf, M. Am. Soc. C. E., was read.

Some data as to the Protection of Piles from the *Limnoria* and *Teredo* in San Francisco Bay, by Marsden Manson, M. Am. Soc. C. E., were presented and the subject discussed.

DECEMBER 21ST, 1887.—The Society met at 20 o'clock. President William E. Worthen in the Chair; John Bogart, Secretary. The Secre-

tary announced the receipt of an invitation from Members resident in Milwaukee and from the Mayor of that city, to hold the next Convention of the Society in Milwaukee.

A paper on The Venturi Water Meter, by Clemens Herschel, M. Am. Soc. C. E., was read and discussed by Messrs. Church, Emery, Striedinger, Croes, Brinckerhoff, North, Flag, Brush and the Author.

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#### OF THE BOARD OF DIRECTION.

DECEMBER 28TH, 1887.—Applications were considered. Report of the Sub-Committee on Professional Training and Technical Education was presented and laid over for consideration. The Secretary was instructed to prepare a draft of the Annual Report, and submit the same for consideration at a future meeting. Arrangements for the Annual Meeting were considered and the President authorized to appoint a committee to perfect the same. Appropriations were made.

## ADDITIONS TO LIBRARY AND MUSEUM.

- From D. H. Ainsworth, Newton, Iowa:  
Third Annual Report of the Board of Railroad Commissioners of the State of Iowa for the year ending June 30th, 1886.
- From Charles A. Allen, Worcester, Mass.:  
Report of the City Engineer in relation to the Disposal of the Sewage of the City of Worcester, Massachusetts.
- From American Institute of Electrical Engineers. Ralph W. Pope, Secretary, New York City:  
Transactions of the American Institute of Electrical Engineers Vols. I, II and III, 1884-86.
- From American Iron and Steel Association, James M. Swank, General Manager, Philadelphia, Penn.:  
Annual Statistical Report of the American Iron and Steel Association for the year 1886.
- From American Institute of Mining Engineers. Dr. R. W. Raymond, Secretary, New York City:  
Concentration and Smelting at Tombstone, Arizona. John A. Church.  
Mining Engineering at the University of Illinois. Dr. Theodore B. Comstock.  
The Animikie Rocks and their Vein-Phenomena, as shown at Duncan Mine, Lake Superior. W. M. Curtis  
Notes on the Saving of Sulphur and Ammonia from Gas. W. H. Adams.  
General Description of the Ores used in the Chattanooga District. H. S. Fleming.  
Magnesium Carbonate as a Non-conductor of Heat. E. Luttgen.  
Apparatus for Volumetric Determinations with Potassium Permanganate. Clemens Jones.  
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The Silver Mines of Calico, California. Waldemar Lingren.
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Geology and Mining in the Northern Coal-field of Pennsylvania. Frank A. Hill.  
The Use of Natural Gas in a Lead Blast Furnace. Francis C. Blake.
- From Edward Atkinson, Boston:  
Table and Diagram showing Areas of States and Foreign Countries with Production of Crops in the United States to 1879.
- From John W. Bacon, Danbury, Conn.:  
Thirty-fourth Annual Report of the Railroad Commissioners of the State of Connecticut.
- From M. D. Banderai, Ingenieur, charge du Service Centrale du Materiel et de la traction de la Compagnie des Chemins de fer du Nord:  
Note sur l'Appropriation du Materiel dit Americain au service de certaine trains express des reseaux Europeiens.
- From William S. Barbour, Cambridgeport, Mass.:  
Annual Report of the City Engineer of the City of Cambridge, Massachusetts, for the year ending November 30th, 1885.  
The Twenty-first Annual Report of the Cambridge Water Board for the year 1885.  
The Mayor's Address at the Organization of the City Government, January 4th, 1886, and the Annual Reports made to the City Council for the year 1885.
- From James Barrowman, Hamilton, Scotland:  
The Glossary of Scotch Mining Terms.
- From Commander J. R. Bartlett, U. S. N., Washington, D. C.:  
Annual Report of the Hydrographer to the Bureau of Navigation for the Fiscal Year ending June 30th, 1886
- From E. S. Bellasis, Assoc. M. Inst. C. E., London, England:  
Roorkee Hydraulic Experiments, E. S. Bellasis  
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- From Gen. S. V. Benét, Washington, D. C.:  
Report of the Chief of Ordnance for the year 1886.
- From John Birkinbine, Philadelphia, Penn.:  
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- From James P. Bogart, New Haven, Conn.:  
Sixth Report of the Shell Fish Commissioners of the State of Connecticut to the General Assembly, January Session, 1887.
- From William W. Bonnett, Waterbury, Conn.:

Twentieth Report of the Board of Water Commissioners of the City of Waterbury, Connecticut, for the year ending December 31st, 1886.

From Alexander Borodin, Engineer in Chief Russian South Western Railways, Kieff, Russia:  
Experiments on the Steam Jacketing and Compounding of Locomotives in Russia.

From G. Bousearen, Cincinnati, Ohio: General Specifications for Highway Bridges and Viaducts of Iron and Steel. G. Bousearen.

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Report on the Works Executed by the Hon. the Commissioners of Sewers of the City of London during the year 1886. William Haywood, London, 1887.

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From Urban H. Broughton, Student Inst. C. E. London, Eng.:  
The Shone Hydro-Pneumatic System of Sewerage.

From C. H. Bunce, Hartford, Conn.:  
Fifteenth Annual Report of the Board of Street Commissioners of the City of Hartford, Connecticut, for the year ending December 31st, 1886.

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Report of the Commissioners of Education for the years 1873, 1884-85.  
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Annual Report of the Chief Signal Officer of the Army to the Secretary of War for the year 1885. Parts I and II.

From Civil Engineers' Club of the University of Illinois, W. R. Roberts, Secretary, Champaign, Ills.:  
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From Major H. W. Clarke, Syracuse, N. Y.:  
Report of the Regent's Boundary Commission upon the New York and Pennsylvania Boundary.

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The Diplomatic Fly-Sheets for Tuesday, March 15th and Tuesday, April 12th, 1884.  
A Message of Peace, M. De Lesseps, Berlin, 1887.

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From George H. Cook, New Brunswick, N. J.:  
Three Atlas Sheets of New Jersey.  
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An Address delivered before the N. Y. Academy of Science on the Isthmian Ship Railway.

From William A. Crafts, Boston, Mass.:  
Eighteenth Annual Report of the Board of Railroad Commissioners of Boston, Massachusetts, January, 1887.

From J. James R. Croes, New York City:  
Contract for Construction of Passenger Stations and Stairways of the Third Avenue Line of the Suburban Rapid Transit Company.

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From Chester B. Davis, Chicago, Ills.:  
Specifications for the Construction of Water Works in the City of Elgin, Illinois.  
Specifications for the Construction of a System of Sewerage in the City of Cedar Rapids, Iowa.

From Detroit Bridge and Iron Works, Detroit, Mich.:  
One framed photograph of Double Track Viaduct over Kettle Creek near St. Thomas, Canada, Michigan Central Railroad.

From Edward Bates Dorsey, New York City:  
Yearly Statement, Performance of Locomotives on the Chicago, Burlington and Quincy Railroad, showing full Expenditures in Detail for the years 1873 to 1885, inclusive.

Catalogue of Books, etc., published by the English Government in 1885 and 1886.  
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Fourth and Fifth Annual Report of the Columbus, Hocking Valley and Toledo Railway Company of the State of Ohio for the year ending December 31st, 1884.

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Geological Section Artesian Well, 1 400 feet, at San Augustine, Florida.



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From Professor A. J. Du Bois, New Haven, Conn.

Science and the Spiritual.

From Gen. James C. Duane, Chief of Engineers U. S. A. Washington, D. C.  
Advertisements, Specifications and Proposals, as follows:

For Dredging in Superior Bay and St. Louis Bay, Wisconsin.

For Dredging, Rock Excavation, Construction of Dikes, etc., in James River, Virginia.

For Dredging in Portland Harbor, Maine.

For Dredging in York Harbor, Maine.

For Dredging in Great Harbor, Wood's Holl, Mass.

For Dredging in Stamford Harbor, Connecticut.

For Dredging in the Harbor at Grand Marais, Minnesota.

Improvement of Beaufort Harbor, N. C.

For Rock Excavation and Dredging to Improve the Channel at Ashtabula Harbor, Ohio.

For Improving Buttermilk Channel, New York Harbor, N. Y.

For Construction of Breakwater at Cleveland Harbor, Ohio.

For Revetment Construction at Saint Clair Ship Canal, Michigan.

For Construction of New Canal Wall and enlarging Basin, and Earth and Rock Excavation in Louisville and Portland Canal.

For Furnishing and Placing Stone on the Breakwater at Rockland, Maine.

For Improving the Channel between Staten Island and New Jersey.

For Dredging in Fort Point Channel, Boston Harbor, Mass.

For Excavating at Middle Neelish Hay Lake Channel, Mich.

For Removing a Rock in Lone Rock Channel, Wood's Holl, Mass.

For Building and Repairing Wing, Dams, etc., in the Savannah River, Georgia.

For Dredging in Apalachicola, Bay and at the Mouth of the Carabelle River, Florida.

Improving Cape Fear River, N. C., at and below Wilmington.

Improving Nanticoke River, Delaware.

Improving St. Jones River, Delaware.

Improvement of Rivers emptying into San Pablo and Suisin Bays.

Improving the Channel over the Bar at the mouth of St. John's River, Florida.

Improvement of Potomac River near Washington, D. C.

Rock Excavation at Grand Chain, Ohio River. Proposals for Timber, Bolts and Stone.

For Levee Work on Mississippi, Yazoo Delta, Levee District.

For Furnishing Timber and Lumber for

Lock Gates at Saint Mary's Falls Canal, Michigan.

For Timber, Bolts, Spikes, Stone and Miscellaneous materials.

For Barges.

Removal of Wrecks in Patapsco River.

Improvement of Tampa Bay, Florida.

For Improvement of Harbor at Grand Haven, Mich.

For Improvement of Harbor at South Haven, Mich.

For Improvement of Harbor at Charlevoix, Mich.

For Improvement of Harbor at Manistee, Mich.

For Improvement of Harbor at Pentwater, Mich.

For Improvement of Harbor at Frankfort, Mich.

For Improvement of Harbor at Muskegon, Mich.

For Improvement of Harbor at Portage Lake (Harbor of Refuge), Mich.

Improving the Harbor at Cedar Keys, Fla.

Improving the Harbor at Wilmington, Delaware.

Improving Ice Harbor at New Castle, Delaware.

Improving Withlacoochee River, Florida.

For Improvement of Roanoke River, N. C.

For Constructing Jetties at Westport Harbor, Massachusetts.

For Improving Harbor at Octonto, Wisconsin.

For Rock for Construction of Jetties at Fort McRee, Pensacola Harbor, Florida.

For Improving Bay, New York Harbor, N. Y.

For Building a Jetty at entrance to Galveston Harbor, Texas.

Improvement of Manatee River, Florida.

For Construction of Masonry of Reservoir. Outlet and Wing Walls of Potomac River, near Washington, D. C.

For Materials, Potomac River, D. C.

For Dredging in Connecticut River, Conn.

For Constructing Dike at Reedy Island, Delaware River.

Constructing Dikes at Spring Bar and Skidmore's Bar, Pamunky River, Va.

Constructing Dikes at Robinson's Bar, Mataponi River, Va.

For Dredging Channel in Back Cove, Portland, Maine.

For Furnishing Materials and Building Five Square-decked Flatboats.

For Furnishing Material and doing the work of Strengthening the Suy Island Levee where it crosses the Suicarte Slough and other Sloughs, as provided for in the River and Harbor Act of August 5th, 1886.

Reconstruction of the Aqueduct Bridge, D. C.

Snag and Tow-boat for Tennessee River, etc.

Machinery for Davis Island Dam, Ohio River.

For Furnishing Material and doing the Work of Building one Closing Dam at Turner's Island; one Protection to small towhead above Turner's Island; one Closing Dam and one Wing Dam at Island 496, together with shore protections for these works.

For Furnishing Timber and Plank, and Iron Bolts and Spikes and Boulder Stone for Crib-work at the Harbor of Refuge at Sand Beach, Michigan.

For Constructing Breakwater at Agate Bay, Minnesota.

- For Improving Newtown Creek, New York.  
 Improvement of Tampa Bay, Florida.  
 Improving Harbor at Redwood, California.  
 Improving the Harbor at Cedar Keys, Florida.  
 For Dredging in the Harbor of Duluth, Minnesota; Repairs to the Piers of Canal and placing Buoys in the Harbor.  
 For Dredging in Boston Harbor, Mass.  
 Improving Ice Harbor at Marcus Hook, Pa.; Construction of Pier.  
 For Extension of East Pier at Fairport Harbor, Ohio.  
 Construction of Hull and Cabin of Dredge-boat; Hull and Cabin for Tennessee River, etc.  
 Improving Buffalo Bayou, Texas.  
 For Iron and Steel for Lock Gates and Filling Valves for La Grange Lock, Illinois River.  
 Construction Dikes and Mattresses, Rappahannock River.  
 For Hydraulic Cement.  
 Improving Entrance to Yaquina Bay, Oregon.  
 For Constructing Dams and Shore Protections of Brush and Rock between Homer, Minnesota, and Queen's Bluff, Minnesota.  
 For Constructing Dams and Shore Protections of Brush and Rock between Sand Prairie and Savanna, Illinois.  
 For Constructing Dams and Shore Protections of Brush and Rock between Guttenberg, Iowa, and Waupecon, Iowa.  
 For Dredging in East Chester Creek, New York.  
 For Dredging in Lubec Channel, Maine.  
 For Dredging in Little Harbor, New Hampshire.  
 For Dredging in Narragansett River, Maine.  
 For Dredging in Penobscot River, near Bangor, Maine.  
 For Filling the Gap in the Breakwater, and Constructing Rip Rap Wall and Jetty at Rock Island, Rhode Island.  
 For Furnishing Rip Rap on Bank of the Mississippi River, between Burlington and Montrose, Iowa.  
 For Furnishing Rip Rap on Bank of the Mississippi River, in vicinity of Alma, Wisconsin.  
 For Furnishing Rip Rap on board Government Barges in the Mississippi River, between Fountain City, Wisconsin and Winona, Minnesota.  
 For Constructing Breakwater at Agate Bay, Minnesota.  
 For Furnishing Timber, Iron, Stone for Oconto Harbor, Wisconsin.  
 For Improving Mouth of Columbia River, Oregon.  
 For Removal of the Wreck of the Steamboat "Maria," now lying in Bayou Leche, near Chasenton, Louisiana.  
 Improvement of Wilmington Harbor, California.  
 For Dredging in Ticonderoga River, New York.  
 For Dredging Harbor at Cheboygan, Michigan.  
 For Dredging at Plattsburgh Harbor, New York.  
 For Dredging West Channel of Saginaw River, along West Bay City, Michigan.  
 Dredging and Rock Excavation, Rappahannock River, Virginia.  
 Approximate Estimate of Materials required for Construction of Parapet Wall.  
 Report relative to the threatened cut-off in the Willamette River.  
 Report relative to Legislation for the improvement of the Des Moines Rapids Canal.  
 Report upon proposed alterations of the Louisville and Portland Canal.  
 Report upon the commerce passing through the Saint Mary's Falls Canal during the year 1886.  
 Report of a Board of Engineers on the proposed reconstruction of the Aqueduct Bridge in the District of Columbia.  
 Report and accompanying maps showing the bank lines of the Plum Point and Lake Providence Reaches.  
 Report concerning the changes which have recently occurred in the harbor at Van Buren, Ark., affecting navigation and facilities for commerce.  
 Report on improvement of the Mississippi River at the Lake Providence Reach and Pitcher's Point.  
 Report by a Board of Engineers upon the expediency of the acquisition by the Government of the Portage Lake and River Improvement Company Canal, and the Lake Superior Ship Canal Railway and Iron Company Canal in the State of Michigan.  
 Report relative to the proposed sale to the Government of the properties of Lake Superior Ship Canal Railway and Iron Company, and of the Portage Lake and River Improvement Company.  
 Report by a Board of Engineers upon the expediency and desirability of acquisition by the Government of the Sturgeon Bay and Lake Michigan Ship Canal.  
 Report on the completion of the Washington Monument.  
 Report upon the commercial value and importance of the works of the Green and Barren River Navigation Company.  
 Report from the Board of Engineers upon the examination and surveys of Wisconsin River from Portage to its mouth.  
 Report of the Board of Engineers relative to bridging the Mississippi River at or near St. Louis.  
 Report from the Chief of Engineers upon the claim of the Standard Underground Cable Company of Pittsburgh, Pa., of Cables laid in the District of Columbia.  
 Reports relating to causeways, bridges, etc., in process of erection that may interfere with navigation.  
 Report of the Board of Engineers upon the proposed acquisition by the Government of the Illinois and Michigan Canal and construction of the Hennepin Canal, made in pursuance to a provision of the River and Harbor Act of August 5th, 1886.  
 Report of Engineers upon the survey of the mouth of Bayou Plaquemine, Louisiana.  
 Reports of Engineers relative to a breakwater at Whaler's Point, California.  
 Report calling for information relative to the right of the City of Louisville to drainage into the Louisville and Portland Canal.  
 Report relative to a channel in Sandusky Harbor.  
 Report relative to the Improvement of the Mississippi River.  
 Report upon the Commercial value and Im-

- portance of the Works of the Monongahela Navigation Company.
- Report relative to River and Harbor Improvements in Oregon and Washington Territory.
- Report of the Mississippi River Commission for the fiscal year ending June 30th, 1886.
- Report of the Engineers relative to money appropriated in River and Harbor Bill used for the Missouri River.
- Report on a Tabulated Statement of Unexpended Balances for River and Harbor Works, November, 1886.
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- Report of the Operations of the Mississippi River Commission from July 1st, 1886, to November 30th, 1886, with Financial Statements relating to Appropriations.
- Report of the Cost of Widening Baltimore Harbor.
- Report on the Purchase of Land for a Dam Site at Herr's Island, Alleghany River.
- Report on the Cost of Improving Saint Mary's River, Michigan, and of Continuing Work on New Lock.
- From John B. Duncklee, Washington, D. C.
- Proposals for the Reconstruction of the Aqueduct Bridge, D. C.
- Specifications for "Reservoir Outlet and Wing Walls," Potomac River Improvement.
- From James B. Eads' Estate, New York City:
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- From Messrs. Ernest and Kom, 90 Wilhelm Strasse, through Charles A. Huckledeyn, late Technical Attaché German Legation at Washington:
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- From George E. Evans, Lowell, Mass.:
- Annual Report of the Lowell Water Board for the years 1881-87.
- From John T. Fanning, Minneapolis, Minn.:
- Report of the Drainage Commission to the Drainage Convention, held at Crookston, Minn., December 8th, 1886.
- From Robert Fletcher, Hanover, N. H.:
- Catalogue of Dartmouth College and the Associated Institution for the year 1886-87.
- From Matthias N. Forney, New York City:
- Report of the Proceedings of the Twentieth Annual Convention of the Master Car Builders' Association, held at Niagara Falls, N.Y., June 8th, 9th and 10th, 1886.
- From James T. Gardiner, Albany, N.Y.:
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- From De Witt C. Gardner, New York City:
- The Inter-State Commerce Act of February 4th, 1887, with a summary of its provisions.

- From Charles Glackmeyer, Montreal, Canada:  
Reports on the Accounts of the Corporation of the City of Montreal and Reports of the City Officials for the year 1885.
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- From Samuel M. Gray, Providence, R. I.:  
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- From Frederick Graff, Philadelphia, Penn.:  
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Second Annual Report of the Board of Public Works of the City of East Saginaw, Michigan, for the fiscal year ending January 3d, 1887.
- From E. B. Guthrie, Buffalo, N. Y.:  
Engineers' Reports of Buffalo, N. Y., 1875-85, and Intercepting Sewer Reports. Waring, Sevy, Smith, Chesbrough and Shea.
- From Henry G. G. Hanks, Sacramento, Cal.:  
Sixth Annual Report of the State Mineralogist of California, Part I. and II. For the year ending June 1st, 1886.
- From F. W. Hodgden, Boston, Mass.:  
Annual Report of the Harbor and Land Commissioners of Massachusetts for the years 1879-80 and 1886.
- Powers and Duties of the Board of Harbor and Land Commissioners.
- From A. H. Howland, Boston, Mass.:  
Statistics of Water Works built by A. H. Howland and George A. Ellis, showing different systems.
- From Hussey, Hoyt & Co., Cleveland, Ohio:  
A description of the Property of the Gogebio Iron Syndicate, together with an account of the Gogebio Iron Range, with maps and illustrations.
- From A. H. Hutton, Baltimore, Md.:  
Annual Report of the Harbor Board of the City of Baltimore, Maryland, for the fiscal year ending December 31st, 1886.
- From Institution of Civil Engineers, James Forrest, Secretary, London:  
Description of the Viaduct over the River Retero. Jurge Raderwacker Grunenwald. Formulas for the Weights of Girder Bridges. Max. Am Ende.
- The Carron Iron Works, Scotland. David Cowan.
- Constantinople Water Works. Frederick Briffault.
- Effect of Temperature on the Strength of Railway Axles. Thomas Andrews.
- Locomotive Engine and Carriage Sheds as used on the Caledonian Railway. Gilbert Macintyre Hunter.
- On the Manufacture of Rolled Joists in Belgium. J. Wolters.
- Abstract of Papers in Foreign Transactions and Periodicals.
- Concrete as applied in the Construction of Harbors, with an abstract of the discussion upon the paper.
- The Electric Light-houses of Macquarie and of Tino. John Hopkinson. With an abstract of the discussion upon the paper.
- Siphon Outlet for a Low Sewer District. Norfolk, Virginia, U. S. A. George E. Waring.
- The Iron Skeleton of the Statue of Liberty on Bedloe's Island, New York Harbor. Theophilus Seyig.
- Friction Clutches. Walter Baeshaw.
- On utilizing Waste Air in Filter Pressing, with some results of Pressing Sewage Sludge at Chiswick. Joseph Hetherington.
- Central Station Electric Lighting. Killingworth W. Hedges.
- Harbor Works in Algoa Bay, Cape Colony. William Shield.
- Irrigation in Lower Egypt. William Willcocks (with an abstract of the discussion upon the paper).
- Disposal of Sewage Sludge, comprising the following papers:  
1st. Sewage Sludge and its Disposal. William Joseph Dibdin.  
2d. Filter Presses for the Treatment of Sewage Sludge. William Santo Crimp (with an abstract of the discussion upon the papers).
- Setting out the Curves of Wheel Teeth. William Isaac Last.
- Salmon Fisheries in Scotland. Alexander Leslie.
- Ailsa Craig Light-house and Fog Signals. Alfred Alan Stevenson.
- Notes upon Useful Japanese Timber. John Henry Tusbury Turner.
- Iron and Brass Foundries, Point St Charles Works, Grand Trunk Railway of Canada. Frederic Lumb Wauklyn.
- Further Investigations regarding Wire Gun Construction. James Atkinson Longridge.
- Australian Timber. George Charnier.
- Administration of Fishing-Boat Harbors in France. (Summary of Information Collected by the Secretary.)
- The Use and Equipment of Engineering Laboratories. Alexander Blackie William Kennedy (with an abstract of the discussion upon the paper).
- Minutes of Proceedings, Vol. LXXXVII, and Vol. XXXVIII, 1886-87, Parts I and II.
- Excerpt Minutes of Proceedings of the Institution of Civil Engineers, Vol. LXXXVIII, 1886-87, Part II.
- From Institution of Civil Engineers of Ireland. John Chaloner Smith, Secretary, Dublin, Ireland:  
Transactions, Vol. XVII.
- From International Congress fur Hygiene und Demographic, Wien, Austria:  
Programme du VI Congrès International De Hygiene et de Demographic, Vienne (Autriche), 1887, du 26 Septembre, au 2 Octobre, 1887.
- From William Jackson, Boston, Mass.:  
Twelfth Annual Report of the Board of Commissioners for the Department of Parks of the City of Boston for the year 1886.
- Twentieth Annual Report of the City Engineer of Boston, Massachusetts, for the year 1886.



From William S. Jackson, Denver, Col.: Statistical Statement of William R. Jackson, President of Denver and Rio Grande Railway, from July 12th, 1884, to December 31st, 1885.

From William W. Jefferis, Philadelphia, Penn.: History of the United States Mint, Philadelphia Pennsylvania.

From W. H. Jennings, Columbus, Ohio: The Comparative Results of Weights and Estimates of Coal in the Hocking Valley.

From Kansas State Historical Society, Topeka, Kansas: Publications of the Kansas Historical Society, Vol. I, 1886.

From R. Kanthers & Sons, Holland City, Michigan: Hydraulic Engineering after the Holland Method.

From Walter Katté, New York City: Annual Reports of the New York Central and Hudson River Railroad Company for the years 1873, '74, '76, '77, '78, '79, '80, '81, '82, '83, '84, '85 and '86.

Report on the Art of War in Europe in 1854-55 and 1856. Major Richard Delafield, Washington, D. C., 1860.

Military Commission to Europe in 1855 and 1856. Major Alfred Mordecai. Washington, 1860.

Report of the Superintendent of the Coast Survey, showing the progress of the Survey during the year 1854. Washington, 1855.

From Louis H. Knapp, Buffalo, New York: Second and Fourth Annual Reports of the Buffalo Water Works.

From J. Francis Le Baron, Jacksonville, Florida: Proceedings of the Southern Society Civil Engineers, Annual Reports for 1885 and 1886, with Professional Papers No. 3.

From Lehigh Valley Creosoting Company, Perth Amboy, New Jersey: One Framed Photograph Lehigh Valley Creosoting Works, Perth Amboy, New Jersey.

From Thomas B. Lee, New York City: Annual Report of the Newark Aqueduct Board for the year ending November 30th, 1884-85 and 1886.

From L'Association Amicale des Anciens Elèves de L'Ecole Centrale des Arts et Manufactures, Paris, France:

Bulletin, November and December, 1886, January and February, 1887, and Annuaire, 1882-1886.

From Charles Julian Light, Secretary Society of Engineers, London: Inaugural Address of the President Prof. Henry Robinson, and Rules, By-Laws and List of Members, etc.

From Hon. Daniel Manning, Secretary of the Treasury, Washington, D. C.: Statistical Abstract of the United States, 1886. Ninth number.

From A. Martens, Berlin, Germany: Ueber das Kleingefüge des schmelzbaren Eisens besonders des Stahles, von A. Martens, Berlin, 1887.

From Niles Meriwether, Memphis, Tenn.:

Biennial Report of the President of Fire and Police Commissioners of the Taxing District of Memphis, Shelby County, Tennessee, December 1st, 1886.

From E. G. Morgan, Secretary Board of Railroad Commissioners, Des Moines, Iowa:

Map and Profiles of the Iowa Railroads, 1881. Annual Reports of the Board of Railroad Commissioners of the State of Iowa for the years 1878-79-81-82-83-84-85 and 86.

From Frank D. Moore, St. Louis, Mo.: St. Lawrence River Steel Bridge over Lachine Rapids, A. and N. W. Ry. at Lachine, P. Q., Canada.

From George S. Morison, New York City:

Four Lithographs of the Rulo Bridge. The Blair Crossing Bridge. A Report by George S. Morison, Chief Engineer. Tenth Census of the U. S., Vol. XVIII, 1880.

From Navy Department, Washington, D. C.:

Annual Report of the Secretary of the Navy with accompanying Documents for the year 1886.

From E. S. Nettleton, Denver, Col.: Third Biennial Report of the State Engineer of the State of Colorado for the years 1885 and 1886.

From New York State Board of Health, Albany, N. Y.:

Monthly Bulletin, December 1886, January and February 1887.

Summary of Mortality of the State of New York for the year 1886.

Sixth Annual Report of the State Board of Health of New York for the year 1886.

From New York Meteorological Observatory, Department of Public Parks, Dr. Daniel Draper, Director, New York City:

Abstract of Registers from Self-recording Instruments, November and December 1886; January, February, March and April 1887.

From Edward P. North, New York City:

Third Report of the Board of Commissioners of Electrical Subways for the City of New York adopted unanimously February 4th, 1887.

Report to the Board of Commissioners of Electrical Subways for the City of New York, submitted July 13th, 1886.

From Albert F. Noyes, West Newton, Mass.:

Annual Report of the City Engineer of Newton, Massachusetts, for the years 1884 and 1885.

From Charles Paine, Pittsburgh, Penn.:

Annual Report of the Philadelphia Company for the years 1886 and 1887.

The Geologic Distribution of Natural Gas in the United States. Charles Ashburner, Philadelphia, Pa., 1886.

From Park Commissioners of Boston, Mass.:

Twelfth Annual Report of the Board of Commissioners of Parks, City of Boston, for the year 1886.

From Prof. George W. Plympton, Brooklyn, N. Y.:  
First, Second and Third Report of the Board of Commissioners of Electrical Subways of the City of Brooklyn, dated September 15th, 1885, April 3d and December 16th, 1886.

From Ernest Pontzen, Paris, France:  
Voies Navigables et Chemins de Fer par MM. E. Pontzen et J. Fleury, Paris, 1887.  
Le Prix de Revient des Transports par Chemins de Fer et la question des voies Navigables en France un Prusse et en Autriche, par W. de Nordling, Paris, 1887.  
Le Chemin de Fer Metropolitan de Paris, par M. E. Delinguy.  
Der Wirthschaftliche Werth der Binnen Wasserstrassen, Dr. Alexander Pez.  
Organisation des Binnenschiffahrts Betriels A. Schronro Wien, 1886.  
Utilite des Canaux Maritimes, A. Gobert.  
Monografien des Donau und der Elbe.

From W. G. Purdy, Chicago, Ills.:  
Sixth Annual Report of the Chicago, Rock Island and Pacific Railway Company, April 1st, 1886.

From George W. Rafter, Rochester, N. Y.:

How to Study the Biology of a Water Supply.

From H. W. Reed, Waycross, Georgia:  
Third Annual Inspection of the Savannah, Florida and Western Railway, August 1886.

From Francis Kinecker, Wuerzburg, Germany:  
Das System Abt in Oertelsbruch.

From A. A. Robinson, Topeka, Kan.:  
Annual Report of the Atchison, Topeka and Santa Fe Railroad Company for the years 1880-81-82-83-84 and 85.

From Frederick H. Robinson, Wilmington, Del.:  
Annual Reports of the Chief Engineer of the City of Wilmington, Delaware, for the years 1871-73-74-75-76-77-78-79-80-81-82-83-84-85 and 86.

From William F. Rogers, Buffalo, N. Y.:  
Annual Reports of the Buffalo Park Commissioners for the years 1875-76-81-82-83-84-85-86 and 87.

From Leo Von Rosenberg, New York City:  
Three Lithographs of East Portal Vosburg Tunnel.

From Friedrich Rudorff, Rector of the Royal Technical High School of Berlin, Germany:  
Rede Zuno Geburtstefeste Seiner Majestät des Kaisers und Königs, Berlin, Germany, 1887.

From John A. Russell, San Francisco, Cal.:  
San Francisco Municipal Reports for the Fiscal Year 1885-86, ending June 30th, 1886.

From William H. Searles, Cleveland, Ohio:  
A Treatise on Bridges and Roofs. John Davenport Crehore.

From Edward W. Serrell, New York City:  
The Hudson Suspension Bridge and New England Railway Company.

From Joshua B. Shaw, New York City:  
Court of Appeals, Brief for Appellant on Motion for Reargument. In the Matter of

the Petition of the New York Cable Railway Company, Appellant, against The Mayor, etc., and others, Respondents.

From W. Shelford, London, England:  
On Some Points for the Consideration of English Engineers with Reference to the Design of Girder Bridges. W. Shelford and A. H. Shield.

From T. Guilford Smith, Buffalo, N. Y.:  
The Trunk Sewer of Buffalo, N. Y.: Its Construction, Cost and Operation. George E. Waring, Jr.

Prospectus of the Lockport Water Supply Co. Appendix Exhibit A. Arbitration Agreement. Frank McLaughlin vs. The Beach Creek, Clearfield and South Western Railway Company and George J. Magee, General Contractor.

Testimony. Frank McLaughlin vs. George J. Magee and the Beach Creek, Clearfield and South Western Railroad Company.

Argument of M. E. Olmsted, on behalf of Defendants, delivered at the Court House, at Lock Haven, Pa., July 22d, 1886. Frank McLaughlin vs. George J. Magee, General Contractor, and the Beach Creek, Clearfield and South Western Railroad Company.

Testimony in the Court of Common Pleas of Clinton County, 12th January, Term 1886. Frank McLaughlin vs. George J. Magee, General Contractor, and the Beach Creek, Clearfield and South Western Railroad Company.

First Annual Report of the Transportation Committee Freight Bureau of the Buffalo Merchants' Exchange.

From G. C. Smith, Chicago, Ills.:  
Annual Reports of the Chicago, Burlington and Quincy R. R. for the Years 1880-81-82-83-84 and 85.

From Society of Engineers, Charles Julian Light, Secretary, London:  
Transactions and General Index, 1861-85.

From Samuel Spencer, Baltimore, Md.:  
Sixtieth Annual Report of B. and O. R.R. for the Year ending September 30th, 1886.

From Waterman Stone, Providence, R. I.:  
Annual Report of the Railroad Commissioners of the State of Rhode Island for the Years 1867-68-73-74-75-76-77-78-79-80-81-82-83-84-85-86 and 87.

From Robert Surtees, Ottawa, Canada:  
Annual Report of the Water Works Committee for the year ending 31st October, 1886.

From Lewis Swift, Director Warner Observatory, Rochester, N. Y.:  
History and Work of the Warner Observatory, Rochester, N. Y. Vol. I, 1883-86.

From William F. Switzer, Chief of Bureau of Commerce and Navigation, Washington, D. C.:

Annual Report and Statement of the Chief of the Bureau of Statistics on the Commerce and Navigation of the United States for the fiscal year ending June 30th, 1886. Part I. Report on the Internal Commerce of the United States. Submitted December 20th, 1886.

From A. N. Talbot, Champaign, Ill.:  
Report of the Second Annual Meeting of the Illinois Society of Engineers and Survey-

ors, held at Champaign, Illinois, January 26th, 27th and 28th, 1887.

From the Estate of D. Van Nostrand, New York City:

First Annual Report of the Denver and Rio Grande Railway. April 1st, 1873.

Turnpike Road Laws. 1841.

Railway and Commercial Information. Samuel Salt.

Missouri, Kansas and Texas Railway Company. Report for 1871.

Twenty-sixth Annual Report of the Railroad Commissioners of the State of Connecticut for 1879.

Railway Analysis. Francis Whishaw.

Examples of the Modes of setting out Railway Curves. Henry Low. Also setting out the widths of ground required for the works of a Railway or Canal. F. W. Simms.

Report of the Metropolitan Board of Works for the year 1872.

Broadway Surface Railroad Company. In the matter of the proposed repeal of the Charter.

The Tehuantepec Railway: Its Location, Features and Advantages under the La Sere Grant of 1869.

Sketch of a Railway judiciously constructed between desirable points, exemplified by a map and an appendix of facts.

Reports on the Bear Mountain Railroad and on the Coal and Iron Ores of the Bear Valley Coal Basin.

A Practical Description of Herron's Patent Trellis Railway Structure. James Heron.

The American Railway Official Manual for the year 1871.

From Frederick W. Vaughan, Louisville, Ky:

Thirty-fifth Annual Report of the Louisville and Nashville R. Co. for the fiscal year ended June 30th, 1886.

From Lieut. Anthony W. Vogdes, Governor's Island, N.Y.:

Our Sea Coast Defences. Eugene Griffin. 1885.

Killed by a Brother Soldier. Brevet Major-General James B. Fry. 1885.

Compulsory Education in the Army. General James B. Fry. 1887.

From Prof. George L. Vose, Boston, Mass.:

Bridge Disasters in America, the Cause and the Remedy.

A sketch of the Life and Works of George W. Whistler. Prof. George L. Vose. Boston, 1887.

From Hon. A. Wagstaff, New York City:

Annual Report of the State Engineer and Surveyor on the New York State Canals, for the fiscal year ending September 30th, 1876.

From George E. Waring, Jr., Newport, R. I.:

The Disposal of Sewage and the Protection of Streams used as sources of Water Supply.

Mechanical Appliances in Town Sewerage. The Removal and Destruction of Organic Wastes.

Architects and House Drainage.

The Trunk Sewer of Buffalo, N. Y. Its Construction, Cost and Operation.

From B. H. Warren, West Chester, Penn.:

Reports of the Microscopical Society of West Chester, Pennsylvania, on the Act of Assembly of said State Awarding a Premium for the destruction of Hawks, Owls, Minks, Weasels, etc., etc., enacted June 23th, 1885.

From Don J. Whittemore, Milwaukee, Wis.:

Twenty-third Annual Report of the Chicago, Milwaukee and St. Paul Railway Company, for the year 1886.

From Prof. De Volson Wood, Hoboken, N. J.:

Thermodynamics. Prof. De Volson Wood.

From Henry R. Worthington, New York City:

The Worthington Steam Pumping Engine. History of its Invention and Development.

From United States Coast and Geodetic Survey, Washington, D. C.:

Report of the Superintendent of the U. S. Coast and Geodetic Survey, showing the Progress of the Work during the fiscal year ending with June, 1885.

From United States Geological Survey, Washington, D. C.:

Monographs of the United States Geological Survey. Vol. X. Othniel Charles Marsh. Washington, D. C., 1886.

Mineral Resources of the United States. Calendar year 1885. J. W. Powell. Washington, 1886.

Sixteen Atlas Sheets of the United States Geological Survey.

Bulletin of the U. S. Geological Survey, No. 30-33.

Monographs, Vol. XI.

Geological History of Lake Lahontan, a quarternary Lake of Northwestern Nevada. Israel Cook Russell. Washington, 1885.

From U. S. Light House Board, Washington, D. C.:

Report showing the effects of the earthquakes of 1886 upon certain United States Light Stations.

From U. S. Navy Department, Washington, D. C.:

Annual Register of the United States Naval Academy, Annapolis, 1885-86.

Report of the Select Committee on Ordnance and War Ships, with an Appendix.

Report of the Naval Advisory Board on the Mild Steel used in the Construction of the Hull, Boilers and Machinery of the "Dolphin" and "Atlanta," "Boston" and Chicago."

Report of a Military Reconnaissance in Alaska made in 1883. Frederick Schwatka, Washington, D. C., 1886.

From other sources:

Indexed Map of Oregon.

Fourth Annual Report of the New York Skin and Cancer Hospital.

Specifications for Bridge across the Missouri River at Rulo, Nebraska.

Report of the Hon. John Bigelow on the Inspection of the Panama Canal in February, 1886.

Philadelphia and Reading Railroad Co., Plan of Reorganization.

Treatise on Cement, compiled and arranged by M. Albert Senel.

Twenty-second Annual Report and Balance Sheet of the Provident Life and Trust Company of Philadelphia, Penn.  
 The Pontifex Patent Ice Making and Refrigerating Machine.  
 The Citometer—An instrument for setting out slopes, stakes, etc.  
 Documents in reference to the General adoption of the Twenty-four Hour Notation on the Railways of America.  
 Hydraulic Engineering after the Holland Method. R. Kanfers, Buffalo, N. Y., 1885.  
 Report of Lieutenant-Colonel James H. Simpson on the change of Route west from Omaha, Nebraska Territory, proposed by the Union Pacific Railroad Company to Hon. James Harlow, Secretary of the Interior, September 18, 1865, with the President's decision thereon.

Special Report by the Massachusetts Board of Railroad Commissioners to the Legislature in relation to the Disaster on Mouday, March 14, 1887, on the Dedham Branch of the Boston and Providence Railroad.  
 Report of the Tests of Metals and other Materials for Industrial Purposes made with the United States Testing Machine at Watertown Arsenal, Massachusetts, during the year ending June 30th, 1884.  
 Recent Legal Decisions on Questions of Title to Real Estate.  
 The History of a Title. A Conveyancer's Romance.  
 Seventeenth Quarterly Report of the Board of Public Works of the City of Providence, R. I., Quarter ending March 31st, 1887.  
 The Source of the Mississippi.  
*The Street Railway Journal*, Vol. I and II.

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## LIST OF MEMBERS.

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### ADDITIONS.

MEMBERS.	Date of Election.
BYLLESBY, HENRY MANSON. . . . . Vice-President and General Manager Westinghouse Electric Co., Pittsburgh, Pa. . . . .	June 1, 1887.
CHURCH, GEORGE EARL. . . . . 9 New Broad st., E. C., London, England . . . . .	Nov. 2, 1887.
COPPÉE, HENRY ST. LEGER . . . . . 220 Washington st., Vicksburg, Miss . . . . .	Oct. 5, 1887.
DERRICK, HENRY CLAY. . . . . Halifax, C. H., Halifax County, Va. . . . .	Oct. 5, 1887.
EGGLESTON, TUCKER CARRINGTON. Resident Engineer, Richmond and Alleghany R. R., Richmond, Va. . . . .	Dec. 7, 1887.
GREENE, JOSEPH NORTON. . . . . Willimantic, Conn. . . . .	Oct. 5, 1887.
GUTHRIE, EDWARD BUCKINGHAM. (Elected Associate, Sept. 3, 1884) Deputy City Engineer, Buffalo, N. Y. . . . .	Oct. 5, 1887.
HAINES, HENRY STEVENS. . . . . General Manager Savannah, Florida and Western R'y, and Charleston and Savannah R'y, Savannah, Ga. . . . .	Nov. 2, 1887.
HARLOWE, CHARLES. . . . . (Care Chief Engineer's Office, St. Paul and Duluth R. R.) St. Paul, Minn. . . . .	Sept. 7, 1887.
HEWITT, CHARLES EDWARD . . . . . Engineer New Jersey Steel and Iron Co., Trenton, N. J. . . . .	Oct. 5, 1887.

- HUMPHREYS, DAVID CARLISLE....Professor Applied Mathematics,  
Washington and Lee Univer-  
sity, Lexington, Va. ....Nov. 2, 1887.
- KIERSTED, WYNKOOP.....Hydraulic Engineer, Water-works  
Building, Kansas City, Mo. . .Oct. 5, 1887.
- KELLEY, WILLIAM DATUS, Jr. ....Special Assistant Engineer, New  
Croton Aqueduct, Tarrytown,  
N. Y. ....Nov. 2, 1887.
- MACKLIN, JOHN GEORGE.....Chief Engineer Mid. Division  
Grand Trunk R'y, Peters-  
borough, Canada. . . . .May 4, 1887.
- MILLER, JAMES IMBRIE.....Principal Assistant Engineer,  
Northern District, New Croton  
Aqueduct, Tarrytown, N. Y. .Oct. 5, 1887.
- MINTURN, ROWLAND ROBINSON...Locating Engineer, Chicago,  
Milwaukee and St. Paul R'y,  
Room 51, Chamber of Com-  
merce, Milwaukee, Wis. ....Nov. 2, 1887.
- MOYLAN, JAMES.....330 Palisade ave., Jersey City,  
N. J. ....Nov. 2, 1887.
- OWEN, FREDERICK NASH.....13 William st., New York City. .Sept. 7, 1887.
- PALMER, CORNELIUS.....Superintendent Bridges and  
Buildings, Peninsula Division,  
Chicago and Northwestern R'y,  
Escanaba, Mich. ....Nov. 2, 1887.
- PARSONS, WILLIAM BARCLAY.....(Elected Junior June 7, 1882.)  
Consulting Engineer, 35 Broad-  
way, New York City. ....Nov. 2, 1887.
- PLAYLE, EDWARD FESSER.... .Assistant Engineer, New Croton  
Aqueduct, Morris Dock, New  
York City. ....Nov. 2, 1887.
- RICKETTS, PALMER CHAMBERLAINE.(Elected Associate Feb. 4, 1886.)  
Wm. Howard Hart Professor  
of Rational and Technical Me-  
chanics, Rensselaer Polytech-  
nic Institute, Troy, N. Y. ....Oct. 5, 1887.
- ROBINSON, ALBERT FOWLER.....Bridge Engineer, Chicago, Bur-  
lington and Northern R. R.,  
St. Paul, Minn. ....Nov. 2, 1887.
- SEAMAN, HENRY BOWMAN.....(Elected Junior June 2, 1886.)  
435 Chestnut st., Philadelphia,  
Pa. ....Dec. 7, 1887.
- SHAW, GRANVILLE WILLIAM.....U. S. Assistant Engineer, P. O.  
Box 124, Louisville, Ky. ....Oct. 5, 1887.
- SIMPSON, ALFRED HOLDEN .....35 Broadway, New York City. .Sept. 7, 1887.
- WHEELER, ORLANDO BELINA .....343 North Eighteenth st., Phila-  
delphia, Pa. ....Nov. 2, 1887.
- WILLIAMSON, FRANCIS STUART ...Engineer Wallis Iron Works,  
Jersey City, N. J. ....Sept. 7, 1887.



## ASSOCIATES.

MORDECAI, GRATZ.....	Office General Superintendent Transportation Pennsylvania R. R., Philadelphia, Pa.....	Oct. 5, 1887.
MOXHAM, ARTHUR JAMES.....	President Johnson Steel Street Rail Co., Johnstown, Pa.....	Nov. 2, 1887.

## JUNIORS.

FIELD, WILLIAM PIERSON.....	Assistant Supervisor Pennsylv- ania R. R., 976 Broad st., Newark, N. J.....	Dec. 7, 1887.
HAWKS, ARCHIE MCLEAN.....	Engineer and Assistant General Manager, Mammoth Spring Improvement and Water Power Co., Mammoth Spring, Ark.....	Nov. 2, 1887,
NORRIS, ROBERT VAN ARSDALE...	P.O.Box 726, Wilkesbarre, Pa...	Dec. 7, 1887.
VAUX, DOWNING.....	Bible House, New York City...	Nov. 2, 1887.
WADA, YOSHICHIKA....	(Care Japanese Consulate.) 7 Warren st., New York City...	Sept. 7, 1887.

## CHANGES AND CORRECTIONS.

## MEMBERS.

APPLETON, ELLERY C.....	Canajoharie, N. Y.
ATWOOD, WILLIAM H.....	Assistant Engineer Lake Shore and Michigan Southern R'y, Cleveland, Ohio.
AULLS, HERBERT L.....	Barclay Block, Room 68, Denver, Colo.
BACON, JOHN W.....	Danbury, Conn.
BAKER, WILLIAM H.....	Box 228, Topeka, Kans.
BARNARD, AUGUSTUS P.....	28 West Twentieth st., New York City.
CANFIELD, EDWARD.....	Chief Engineer New York, Ontario and Western R'y, Middletown, N. Y.
CROSBY, WILSON.....	125 Hammond st., Bangor, Maine.
CULYER, JOHN Y.....	Civil Engineer and Landscape Architect, Pot- ter Building, Park Row and Beekman st., New York City.
DEANS, JOHN STIRLING.....	Assistant Engineer Estimating and Designing Department, The Phoenix Bridge Co., Phœ- nixville, Pa.
DOANE, EDWIN A.....	Hapeville, Fulton Co., Ga.
DODGE, JOSEPH T.....	20 Third ave., West Duluth, Minn.
DUN, JAMES.....	Chief Engineer St. Louis and San Francisco R. R., St. Louis, Mo.

FLAGG, J. FOSTER.....	(Care Am. Soc. C. E.), 127 East Twenty-third st., New York City.
GATES, HORACE D.....	Deputy City Engineer, 2532 Sutter st., San Francisco, Cal.
GIELOW, HENRY J.....	195 Green ave., Brooklyn, N. Y.
HEUER, WILLIAM H.....	Major Corps of Engineers, U. S. A., Room 89 Flood Building, San Francisco, Cal.
HILGARD, JULIUS E.....	1349 L st., Washington, D. C.
KENNEDY, WILLIAM H.....	Chief Engineer Oregon R'y and Navigation Co., Portland, Ore.
LIBBY, EDMUND D.....	Wilmington, Del.
LOCKE, AUGUSTUS W.....	North Adams, Mass.
MITCHELL, HENRY.....	U. S. Coast Survey, Washington, D. C.
MONROE, J. ALBERT.....	New London, Conn.
MOSMAN, ALONZO T.....	U. S. Coast Survey, Washington, D. C.
MOULTON, MACE.....	Consulting Engineer, Eastern Depot, Boston, Mass.
PARTRIDGE, JOHN A.....	315 4½ st., N. W., Washington, D. C.
PEGRAM, GEORGE H.....	Consulting Engineer, 18 Broadway, New York City.
RAFTER, GEORGE W.....	Civil and Sanitary Engineer, 45 Reginald's Arcade, Rochester, N. Y.
ROSS, JAMES.....	P. O. Box 788, Sherbrooke, Canada.
RUDLOFF, HENRY F.....	(Care Chr. Tams & Co.), Puerto Cabello, Venezuela.
SIMPSON, GEORGE F.....	(Care Boston Heating Co.), 63 Pearl st., Boston, Mass.
STEVENS, FRANK S.....	Division Engineer, Main Line Div., Philadelphia and Reading R. R., Reading, Pa.
THACHER, EDWIN.....	Chief Engineer Decatur Iron Bridge and Construction Co., Decatur, Ala.
WOOD, JOSEPH.....	General Superintendent Transportation Pennsylvania Co. Lines West of Pittsburgh, Pittsburgh, Pa.

## JUNIORS.

BAIER, JULIUS.....	Assistant Engineer with Robert Moore, 325 Chestnut st., St. Louis, Mo.
CONNETT, ALBERT N.....	Assistant Engineer with Knight & Bontecon, Room 35, Security Building, Kansas City, Mo.
DURYEA, EDWIN, Jr.....	Assistant Engineer Cairo Bridge, Cairo, Ill.
MARVIN, CHARLES E.....	Roadmaster Georgia Central R. R., Savannah, Ga.
YOUNG, HERBERT A.....	Principal Assistant Engineer Clear Lake Improvement Co., St. Helena, Cal.

## RESIGNATIONS.

## MEMBERS.

CAMPBELL, JOHN C.....	Dec. 31, 1887.
MCCEA, JAMES .....	Dec. 31, 1887.

## ASSOCIATE.

HOWES, FRANK H. ....	Dec. 31, 1887.
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## JUNIOR.

RUPLE, COMMODORE P.....	Dec. 31, 1887.
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## DEATHS.

BERESFORD, FRANK .....	Elected Junior Sept. 7th, 1887; died Dec. 12th, 1887.
EMONTS, WILLIAM A. G.....	Elected Junior Sept. 6th, 1876; died Nov. 5th, 1887.
FALCONNET, EUGENE F.....	Elected Member June 3d, 1874; died Oct. 14th, 1887.
VAUGHAN, FREDERIC W.....	Elected Member Feb. 17th, 1869; died Oct. 14th, 1887.

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